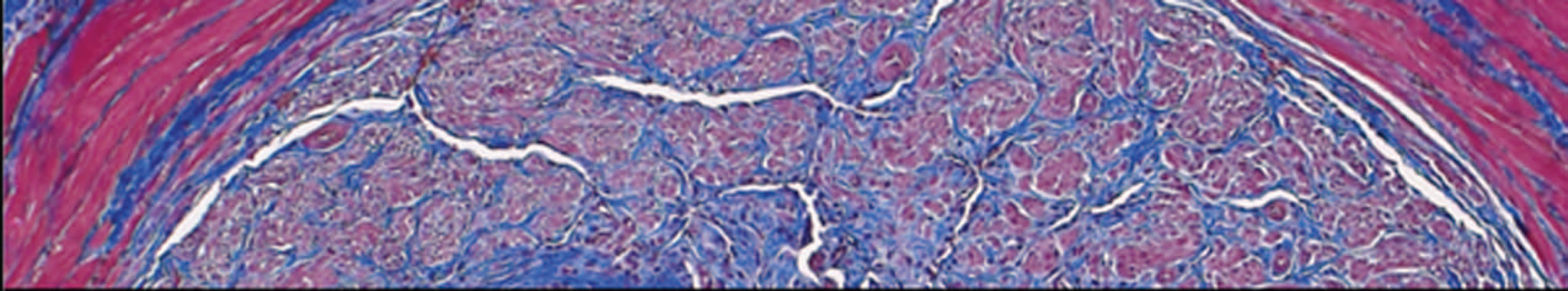

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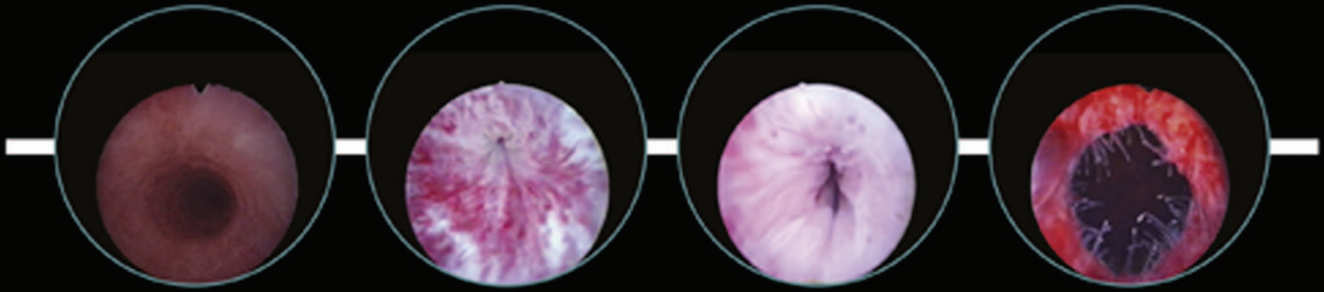

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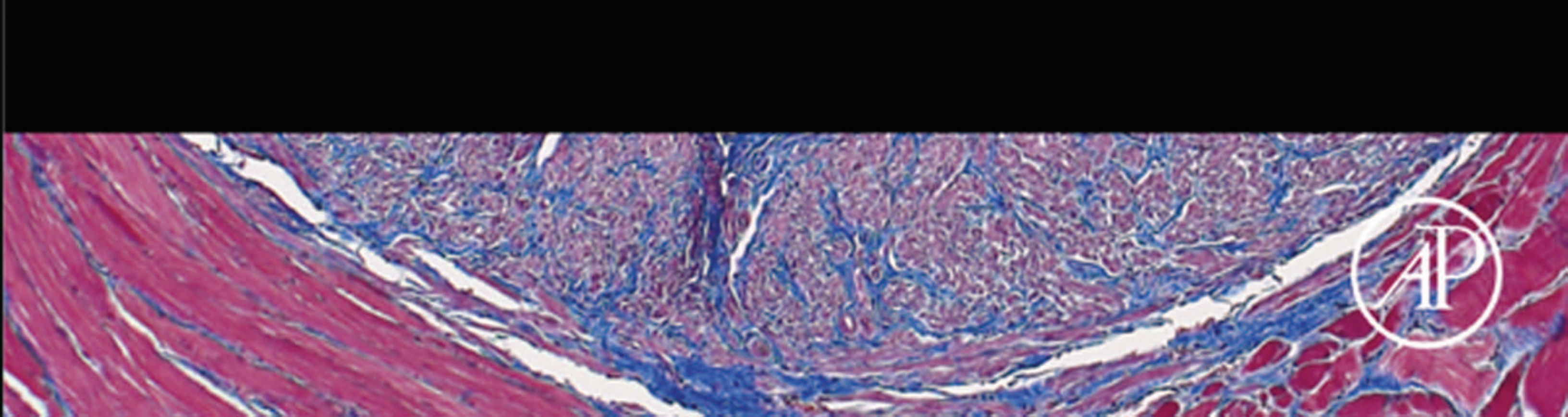

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HANDBOOK OF ENDOUROLOGY

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Preface

During the last decades, within the most specialized medical fields, technology has supported and accelerated the development of modern healthcare, particularly when referring to the newly introduced therapeutic approaches.

The idea of a natural path (preshaped) has its major benefits when implementing minimally invasive surgery, thus significantly impacting on the quality of life. Regardless of the social environment, education degree, and experience background, most of the patients nowadays will certainly choose a less traumatic solution for treating their medical conditions, creating the premise for a faster postoperative recovery to be achieved. Therefore, it is understandable that, within the urological field, new technological developments conclusively impacted on the diagnostic and treatment modalities for most diseases.

The *Handbook of Endourology* represents a remarkably rare editorial event for the international urology related literature. Completing such a scientific material has turned out to be quite difficult, especially under the circumstances of an unprecedented and continuous development in endourology. On the other hand, a current synthesis of the endourological therapeutic armamentarium is absolutely compulsory while aiming to achieve the adequate standards of contemporary good clinical practice.

Our *Handbook of Endourology* includes in its structure a comprehensive description and analysis of all available endoscopic methods. It is a unitary manuscript, as it was drafted by a team of urologists specifically trained in this field (based on an experience of about 100,000 endoscopic procedures performed during the last 25 years).

This handbook continues the publishing tradition of the last 10 years of the Urology Department of Saint John Emergency Clinical Hospital, Bucharest, by publishing various works, especially in the modern fields of endourology: *Atlas of Endourology – Images and Techniques* (2006), *Ureteroscopy* (2008), and *The Endoscopic Surgery of the Inferior Urinary System* (2010). The amplitude and diversity of an endoscopic surgical approach of the entire urinary system were compiled within these reference monographs.

As mentioned in other papers, I would especially like to remind the reader of the first book published within the "endourology series," *Atlas of Endourology – Images and Techniques*, which can be found on the website of the European Association of Urology. The manuscript in question was recommended by various internationally recognized reviewers to all European urologists during their training, but not only then!

After an extensive publishing activity of over 1000 references, as main author (copy editor) or as one of the coauthors of 21 books, I strongly believe that it was necessary for the entire urological world to publish a handbook to particularly include the minimally invasive endoscopic techniques for an exceptional medical field such as urology.

After all, in various clinical centers and for different types of health care services, over 85% of the daily activities belong to endourology! The support and interest is therefore obvious as the basis of this handbook.

The *Handbook of Endourology* is structured into five books, including 61 chapters and is entirely based on personal or coworkers' imagery (patients who were admitted and underwent surgery during the past 30 years in our center). The more than 4000 images of "full color" endoscopic surgery recorded the most significant moments of endoscopic diagnosis and treatment of the entire urological pathology.

Book 1, *Endoscopic Diagnosis and Treatment in Urethral Pathology*, analyzes the urethral diagnosis and modern treatment elements.

We described the endoscopic aspects of diagnosis and minimally invasive treatment of the urethral pathology: optical urethrotomy in men, ureteric stents, urethral strictures in women, lithiasis, and intraurethral foreign bodies, urethral tumors, urethral traumas, endoscopic treatment of urinary incontinence, endoscopic management of the urethral malformations, etc. I believe that even under the presently remarkable technical conditions of modern endourology, open surgery is still present in particular situations, recommended by its favorable outcomes as well as by its current developments. Based on this premise, it would be fair to say that we should not ask endourologic techniques, within some chapters of the urethral pathology, for more than it can deliver!

The *Handbook of Endourology* is aimed especially at urologists, but it can be of interest to specialists in all domains as it assesses the exceptional evolution of medical facilities, new digital technologies, new lasers, high definition systems (video HD and recording), etc., applied in the worldwide recognized urological centers. Most of the endourological procedures and techniques (including the top ones in the years 2013 and 2014) are described and analyzed within this handbook (based only on personal experience).

I would also like to thank the sponsors for their generosity that made the publishing of this handbook possible. Finally, I believe that on both a scientific as well as on an educational level, the *Handbook of Endourology* will have the expected impact on helping to train the modern young urologists. At the very same time, it may well be useful in improving the knowledge of experienced urologists.

Endoscopic Diagnosis and Treatment in Urethral Pathology represents the first contribution of the five volumes that will represent the *Handbook of Endourology*.

Editor
Professor Petrişor Aurelian Geavlete, MD, PhD

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CHAPTER

1

Anatomy of the Urethra

Răzvan Mulţescu, Emanuel Alexandrescu, Bogdan Geavlete

1.1 MALE URETHRA

1.1.1 Descriptive Anatomy

The male urethra, like the female, is divided into several parts, each with distinct anatomical landmarks. Due to its longer length and to the presence of the prostate, these landmarks are much more evident in the male urethra. Another difference between the male and the female urethra is that the former, besides its urinary role, also has a reproductive function in the passage of semen during ejaculation.

The male urethra is 17.5–20 cm long and is divided into two distinct regions: anterior and posterior. The line of demarcation between the two segments is represented by the external striated urethral sphincter or the urogenital diaphragm, passed at this level by the urethra (Moore et al., 2005).

The posterior urethra is divided into the prostatic and the membranous urethra, while the anterior urethra is divided into the penile and the bulbar urethra.

The external urethral meatus (urinary meatus) represents the distal limit of the male urethra; it is shaped as a 6 mm long vertical slot and is one of the narrowest segments. The penile urethra, the longest and the most mobile part of the urethra, is surrounded by the corpus spongiosum, is approximately 15 cm long, and has a homogeneous diameter of 6–7 mm, with the exception of the fossa navicularis. The openings of the periurethral glands (or Littre glands), which are located in the submucosal tissue, are found at the level of the penile urethral mucosa. The mucus secreted by these glands is incorporated into the semen during ejaculation. The Lacunae of Morgagni (the urethral lacunae), where the glands of Littre open, are small depressions or recesses found on the surface of the mucosa of the penile urethra.

The largest of these recesses, which is called the lacuna magna (or the sinus of Guérin), is located on the upper part of the fossa navicularis and is occasionally noticed during endoscopic exams (Dyson, 1995).

The second segment of the anterior part is the bulbar urethra, which has a higher diameter compared with the penile urethra. Some anatomical classifications overlooked this segment of the male urethra, including in the penile part. The bulbar urethra starts at the level of the suspensory ligament of the penis, passes through the bulb, being surrounded by the bulbocavernosus muscle, and ends in the distal part of the external sphincter.

The posterior urethra is located between the urogenital diaphragm and the neck of the bladder.

The membranous urethra is the shortest and the less distensible part of the male urethra. With the exception of the urinary meatus, this is also the segment with the smallest diameter. Like the bulbar urethra, its direction is obliquely downward and forward, being slightly curved with the concavity directed forward and upward. Anterior to the membranous urethra, the dorsal vein of the penis enters the pelvis between the transverse and the arcuate pubic ligaments, while the bulbourethral Cowper glands are located posterior and lateral. The membranous urethra is 12–20 mm long and is surrounded by the fibers of the external striated urethral sphincter.

The prostatic urethra is 25–30 mm long, is the largest and most distensible part of the male urethra, and has an almost vertical position inside the prostate, which it passes from the base up to its apex. A longitudinal elevation called verumontanum or urethral crest is located on the posterior wall of the prostatic urethra (Fig. 1.1).

The verumontanum is 15–17 mm long and 3 mm in height and has a structure made from muscle and erectile tissues (Kobelt). Small depressions are located on both slopes of the verumontanum into which the prostatic ducts open. The extremity of the verumontanum has a median elevation called the seminal colliculus, into which the ejaculatory ducts and the prostatic utricle open (Dyson, 1995; Moore et al., 2005).

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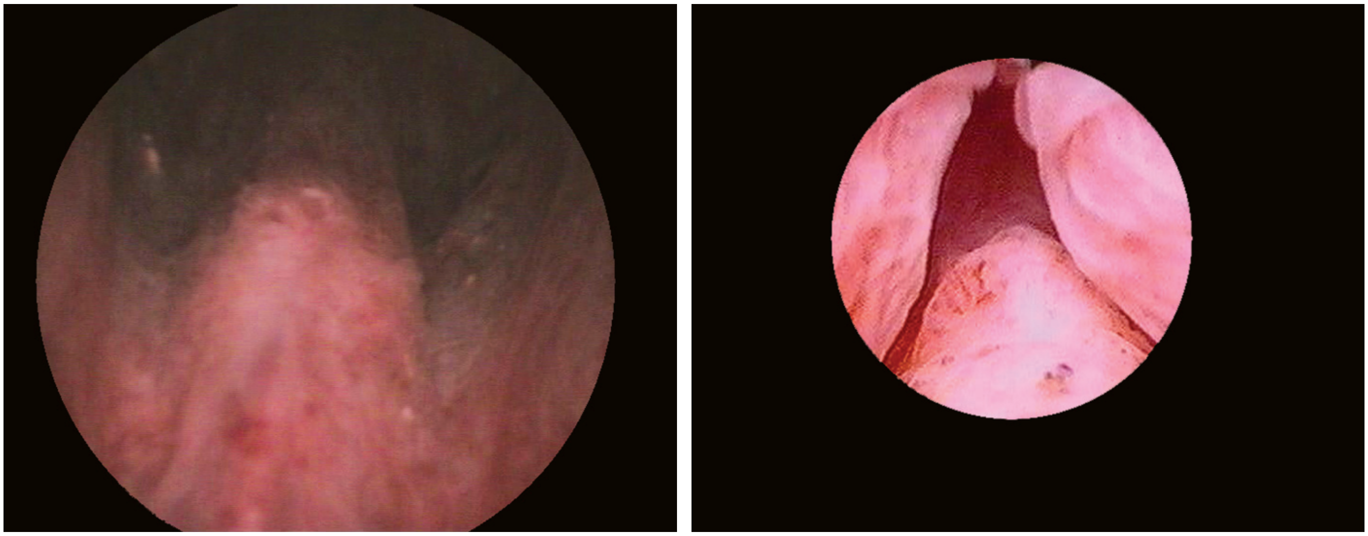

FIGURE 1.1 **Endoscopic appearances of the verumontanum.**

Histologically, the urethra is composed of mucosa and the submucosal connective tissue, which connects to different surrounding structures. The fossa navicularis has a nonkeratinized stratified squamous epithelium, while the rest of the urethral mucosa is a transitional columnar epithelium similar to the rest of the urinary epithelium. The submucous layer is made from erectile vascular tissue surrounded by a layer of circular smooth muscle fibers.

1.1.2 Endoscopic Anatomy

Identification of different urethral segments during urethroscopy is based on anatomical landmarks and on changes in the caliber and the trajectory that are specific to each segment.

The first endoscopic landmark of the penile urethra is the fossa navicularis, a dilated part located at the level of the penile glans and noticed immediately after passing the urethral meatus. This is a frequent location of urethral strictures.

The rest of the penile urethra is inspected after passing through the fossa navicularis, focusing on the appearance of the mucosa, vascularization, distensibility, and any changes in diameter. There are no other peculiar endoscopic elements up to the level of the bulbar urethra.

The appearance of the mucosa is relatively flat, pinkish in color, without any sudden changes in diameter (Fig. 1.2). These characteristics may be altered by different diseases. In urethritis the mucosa is red, hyperemic, with a tiger-like appearance (Fig. 1.3), edematous (Fig. 1.4), and sometimes with annulary stacked narrowings (Fig. 1.5).

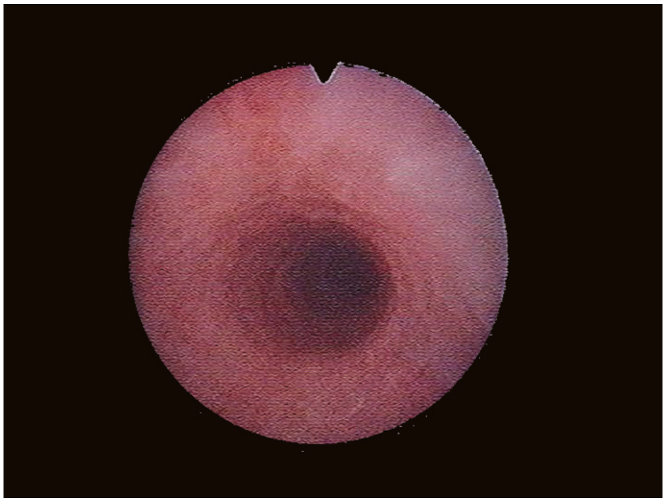

FIGURE 1.2 **Endoscopic appearance of the penile urethra.**

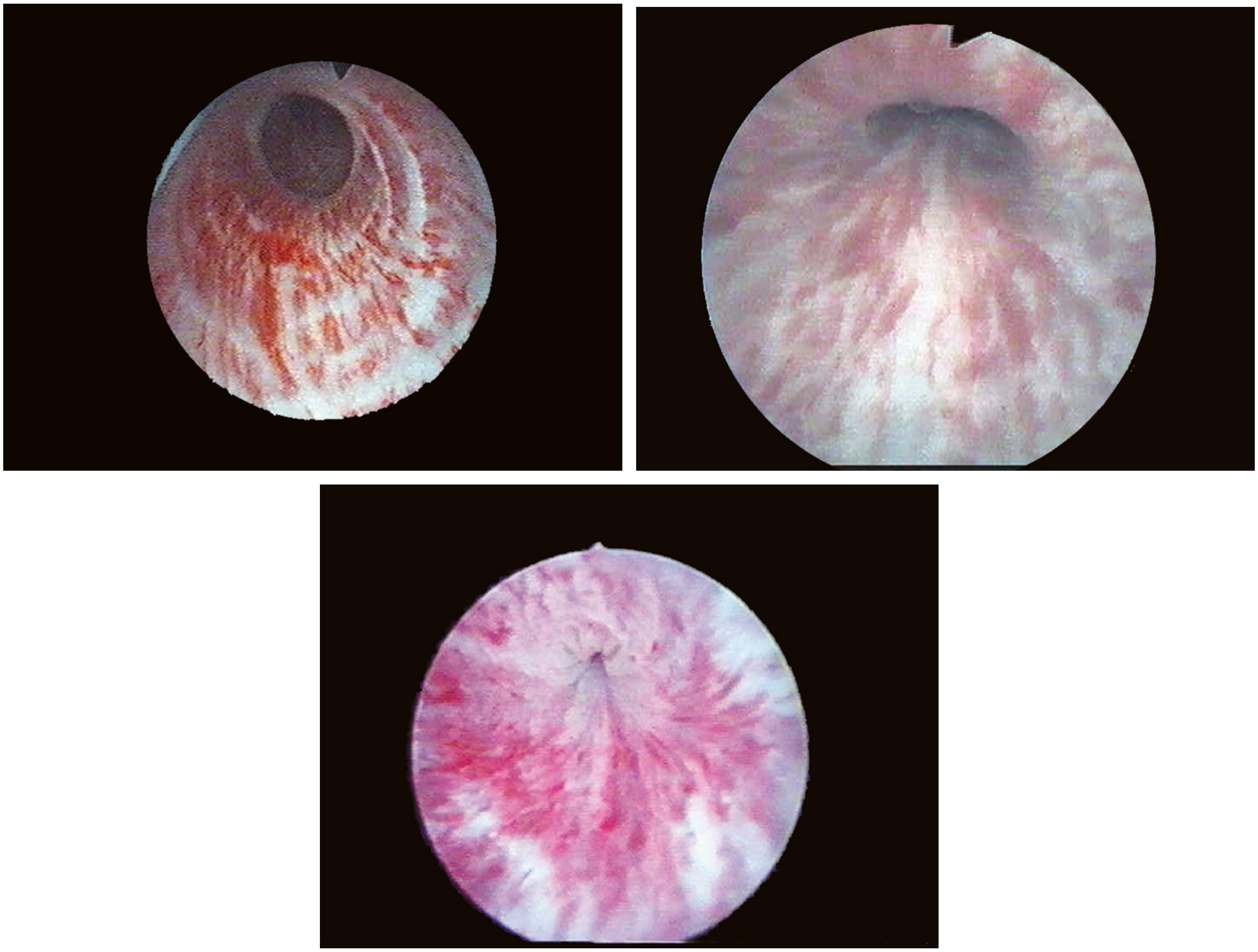

FIGURE 1.3 Tiger-like hyperemic mucosa in urethritis.

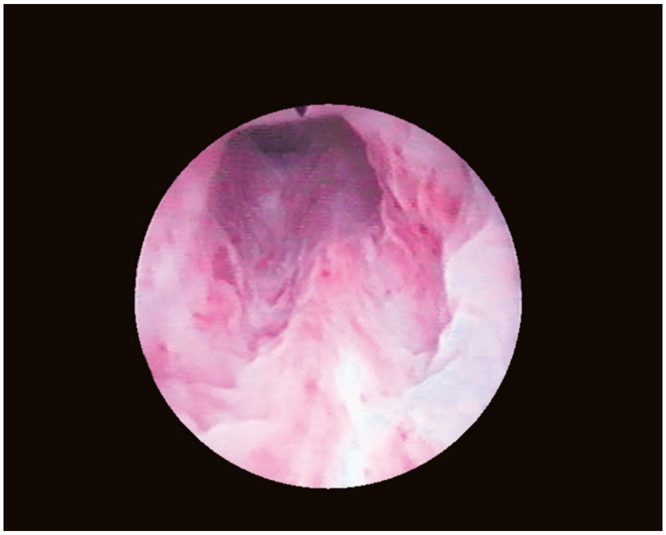

FIGURE 1.4 Edema of the urethral mucosa.

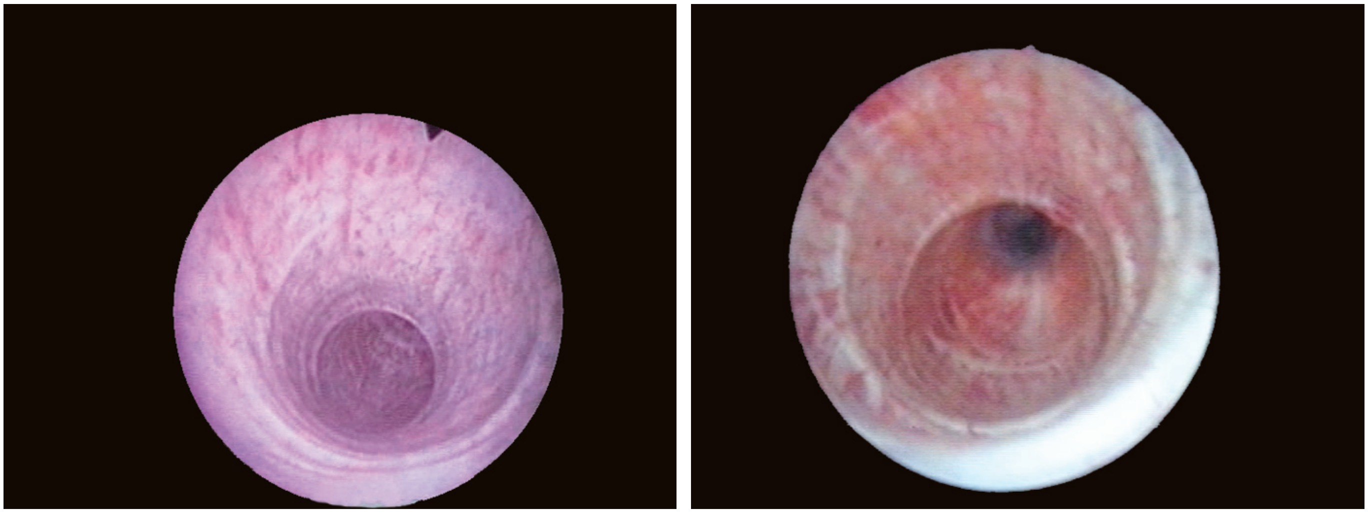

FIGURE 1.5 Large stacked stenoses in patients with urethritis.

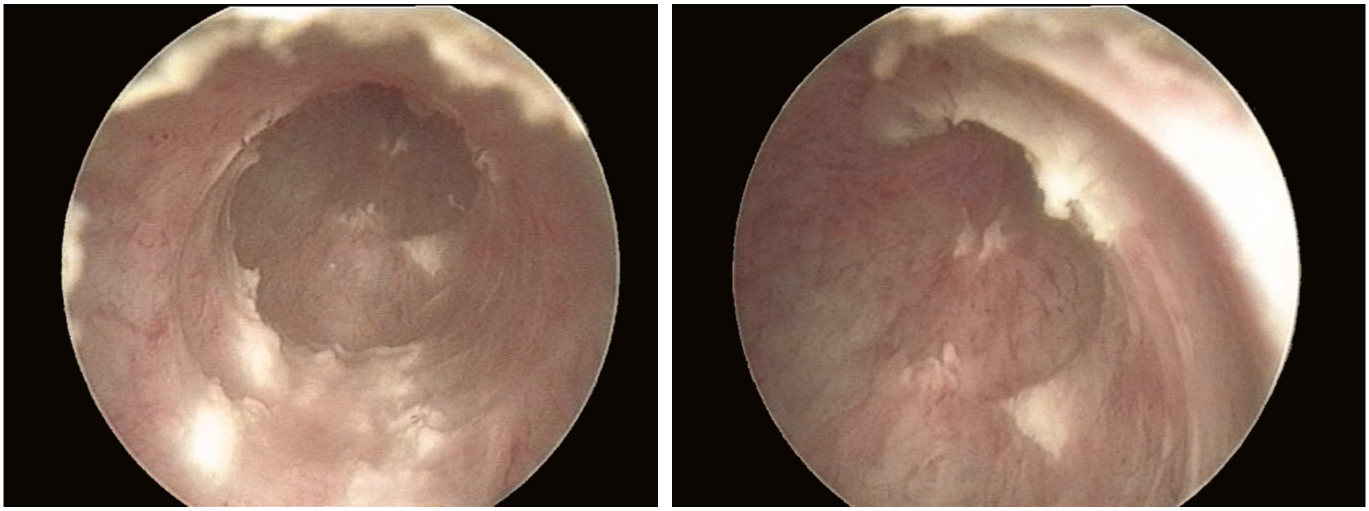

FIGURE 1.6 Tuberculous lesions in the urethra.

White deposits and areas of necrosis can be seen in certain infections, such as the very rare tuberculous infections (Fig. 1.6).

The bulbar urethra is identified during endoscopy by changes from a homogeneous diameter and relatively straight character of the spongious part to a higher caliber and oblique position of the next urethral segment (Fig. 1.7).

In order to pass this difficult region during endoscopy, a combination of progression and gradual tilting of the cystoscope is required, with the aim of elevating its distal part. For this reason, the bulbar urethra is the place where most injuries occur during urethrocystocopy and, implicitly, the most frequent location of iatrogenic urethral strictures.

The membranous urethra has the same oblique position as the bulbar urethra, is small in length and diameter, and is less distensible. Passing this segment during endoscopy is difficult for all these reasons. The external striated sphincter, which is located at the level of the membranous urethra, has an endoscopic appearance of a circular narrowing of the lumen, with radial mucosal folds (Fig. 1.8). During a dynamic study this sphincter opens and closes, acting like a diaphragm.

After passing the external sphincter, the prostatic urethra, which is the largest part of the male urethra, is next. The lower limit of this segment is the verumontanum (Fig. 1.9), with the openings of the ejaculatory ducts seen during endoscopy.

The prostatic urethra is delimited laterally by the two prostatic lobes (Fig. 1.10).

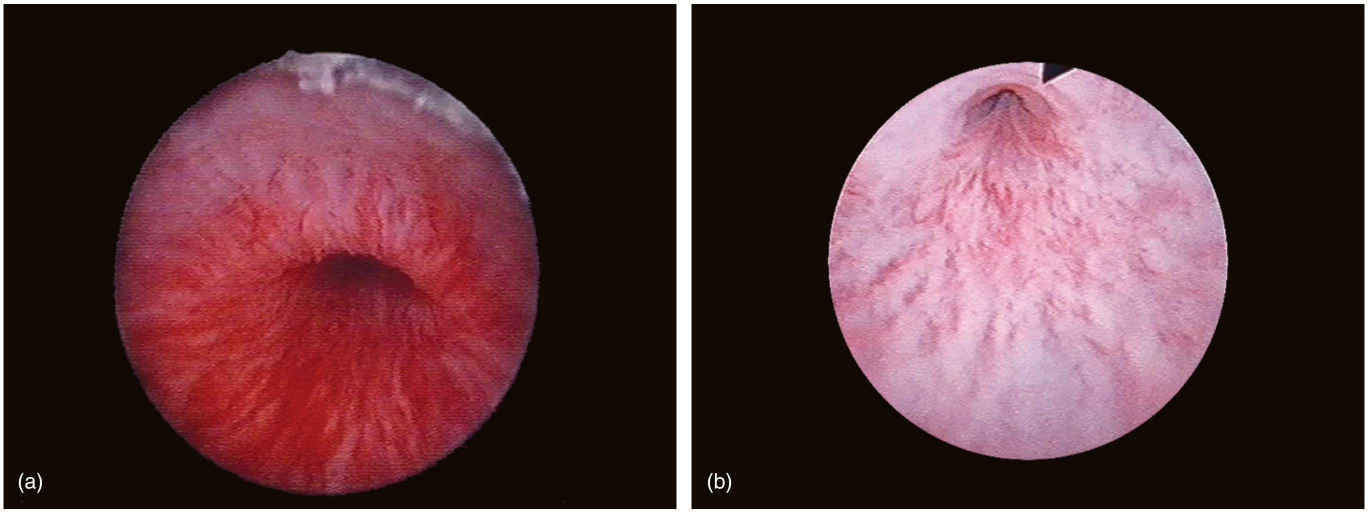

FIGURE 1.7 Endoscopic appearance of the bulbar urethra in its (a) distal and (b) proximal part.

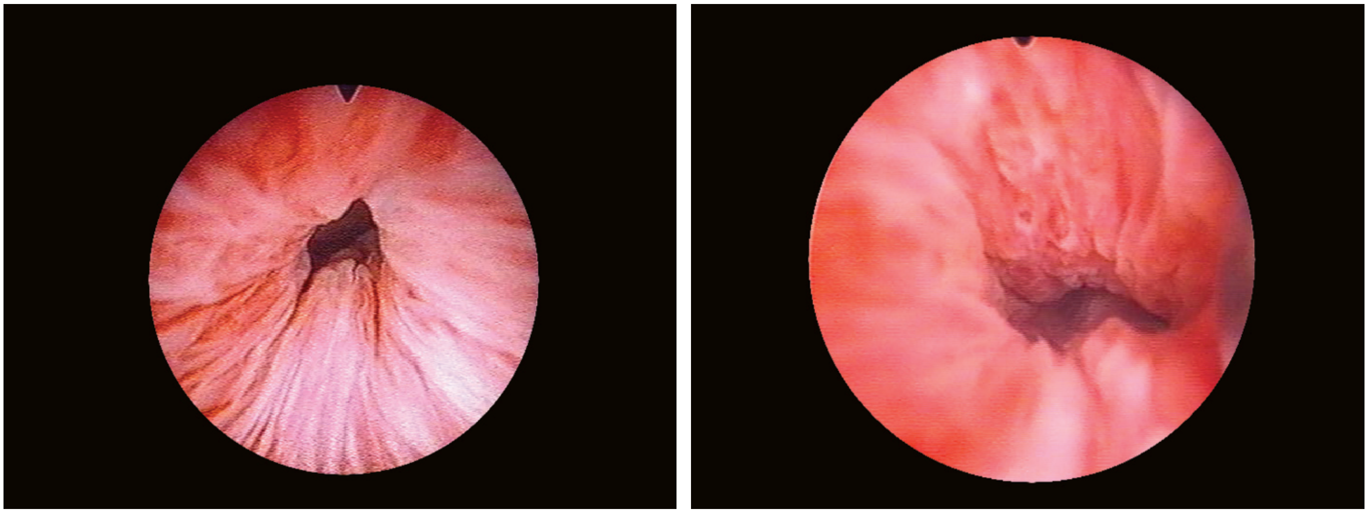

FIGURE 1.8 Endoscopic appearance of the external urethral sphincter.

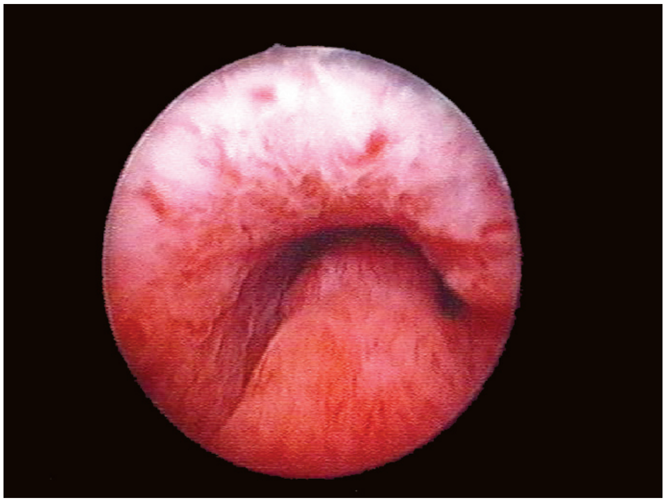

FIGURE 1.9 The lower part of the prostatic urethra, marked by the verumontanum.

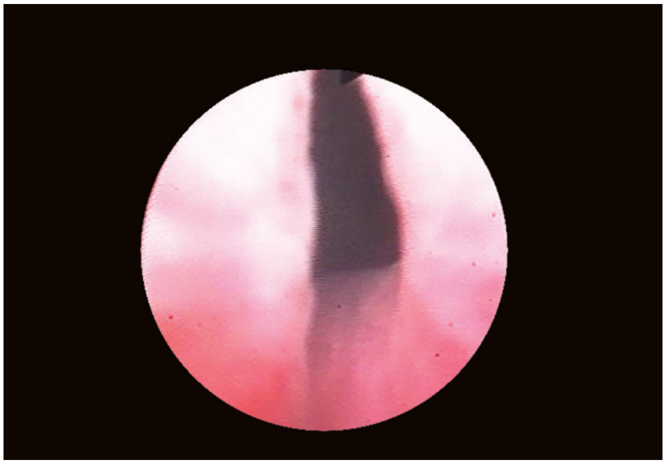

FIGURE 1.10 **Endoscopic appearance of the prostatic urethra, between the two prostatic lobes.**

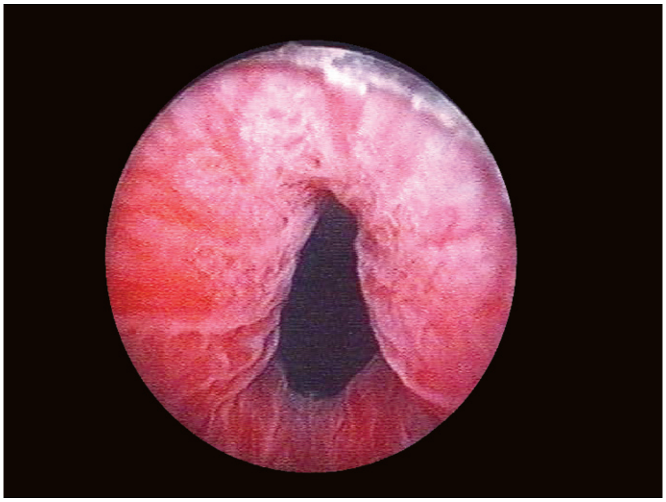

FIGURE 1.11 **Endoscopic appearance of the neck of the bladder.**

The shape and dimensions of the prostatic urethra may vary, depending on the patient's age and on the eventual presence of prostate pathology. In the elderly, the urethral lumen is significantly elongated and narrowed because of the increased volume of the lateral lobes due to benign prostatic hyperplasia.

The neck of the bladder is the last endoscopic landmark and, at the same time, is the distal limit of the prostatic urethra (Fig. 1.11).

Other abnormal changes, which may be identified during endoscopy in different parts of the urethra, are strictures, calculi, benign or malignant tumors, diverticula, etc.

1.2 FEMALE URETHRA

1.2.1 Descriptive Anatomy

The female urethra extends from the neck of the bladder to the urethral meatus and is 3–5 cm long. The urethral meatus has the shape of a 5–6 mm anteroposterior slot which opens into the vaginal vestibule, approximately 2 cm below the clitoris. The female urethra is located under the pubic symphysis and is embedded in the anterior wall of the vagina in its distal two-thirds (Gosling et al., 1983; Dyson, 1995). Its direction is obliquely forward and downward, and it is slightly curved with the concavity directed forward. The presence of this physiologic position is essential in order to maintain urinary continence. The anatomical particularities of the female urethra may explain the increased incidence of urinary incontinence and of urinary tract infections in women.

Histologically, the urethra is a fibromuscular channel consisting of the mucosa, the submucosa, and a muscular layer. Proximally, the transitional epithelial-like mucosa is continued by that of the bladder, while distally it is replaced by a nonkeratinized stratified squamous epithelium. The lamina propria of the urethral wall contains a plexiform vascular network with longitudinal blood vessels (arterioles and venules with thin walls) sustained by a stroma made from collagen and elastine. The mucosa and the submucosa act synergistically to obtain the proper pressure for urethral closure (Raz et al., 1972). The tissues at this level are oestrogen dependent, explaining the stress urinary incontinence observed in postmenopausal women, with a deficit of these hormones (Klutke and Bergman, 1996).

The muscular wall of the urethra is made from an external layer of striate muscle tissue and an internal layer of smooth muscle fibers. The internal layer continues proximally with that found in the neck and trigone of the urinary bladder, while distally it ends in the subcutaneous tissue surrounding the urethral meatus. The smooth muscle fibers are arranged in a deep, well-represented, longitudinal layer and a superficial, thin, circular layer. Colleselli describes three smooth muscle layers in the proximal third and partially in the middle third of the urethra (Colleselli et al., 1998).

In the proximal two-thirds of the urethra, a circular layer of striated muscle tissue (called the rhabdosphincter) surrounds the smooth muscle layer. Between the two fascia of the urogenital diaphragm, the striated muscle forms the striated sphincter, which completely surrounds the urethra and distally fans out laterally along the inferior border of the pubic ramus, fixing the urethra against the anterior vaginal wall. At the level of the vaginal vestibule, the striated muscle completely surrounds the urethra and vagina, forming a urethrovaginal sphincter. These three groups of muscular structures contribute together in obtaining a constant urethral tonus (Oelrich, 1983; DeLancey, 1994).

The pubourethral ligaments lie between the inferoposterior edge of the pubic symphysis and the junction between the middle and proximal thirds of the urethra, keeping the urethra forward. These ligaments consist of fibers of the vesical detrusor and have a role in urethral stabilization during micturition. The lateral fibers of the pubococcygeus muscle laterally hold up the female urethra (Zacharin, 1968).

The proximal part of the urethra is responsible for passive continence, the middle third, with the rhabdosphincter, has roles in both passive and active continence, while the distal part is simply a channel that, in case of injury or surgical resection, usually has no impact on continence (DeLancey, 2003).

Many glands are located in the submucosa, especially in the posterior wall, which is close to the vagina, most of them in the middle and distal third of the urethra. These glands open into small recesses located immediately lateral to the median line. The orifices of the periurethral (Skene) glands are located immediately above the urethral meatus. For this reason urethral diverticula, which may develop after cystic dilatation of these glands, have a similar position, more frequently on the posterior urethral wall.

1.2.2 Endoscopic Anatomy

Exploration of the female urethra begins with inspection of the urethral meatus.

A normal urethra may have different endoscopic aspects but usually it is pink with small mucosal folds. Submucous vascularization is well developed and visible especially in young women, in contrast to the pale and flat aspect of the mucosa in the postmenopausal period or after radiotherapy. Variations in the endoscopic aspects of the urethral mucosa are not necessarily associated with diseases of the urinary tract.

A longitudinal protuberance of the mucosa, called the urethral crest, is observed along the entire posterior urethral wall, giving the lumen the appearance of a transverse slot.

As with the male urethra, the female urethra is divided by the urogenital diaphragm into an anterior and a posterior segment, but the endoscopic criteria of demarcation between these parts are not well defined. The female urethra has the endoscopic aspect of a diaphragm along its entire length, and distension using irrigation fluid is required for proper viewing (Fig. 1.12).

The urethrovesical junction is represented by the bladder neck, which has a circular or a horseshoe shape during endoscopy (Fig. 1.13).

An important edema of the mucosa of the bladder neck in women with inflammatory lesions of the urinary bladder and of the urethra may cause a series of pseudopolypoid formations (Fig. 1.14).

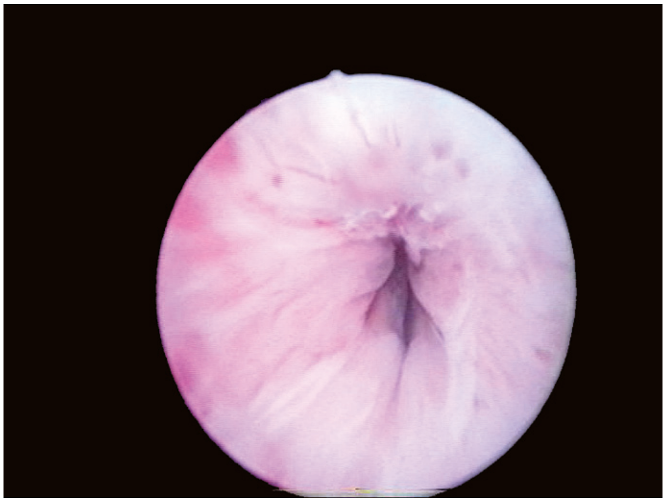

FIGURE 1.12 **Normal endoscopic appearance of the female urethra with longitudinal mucosal folds.**

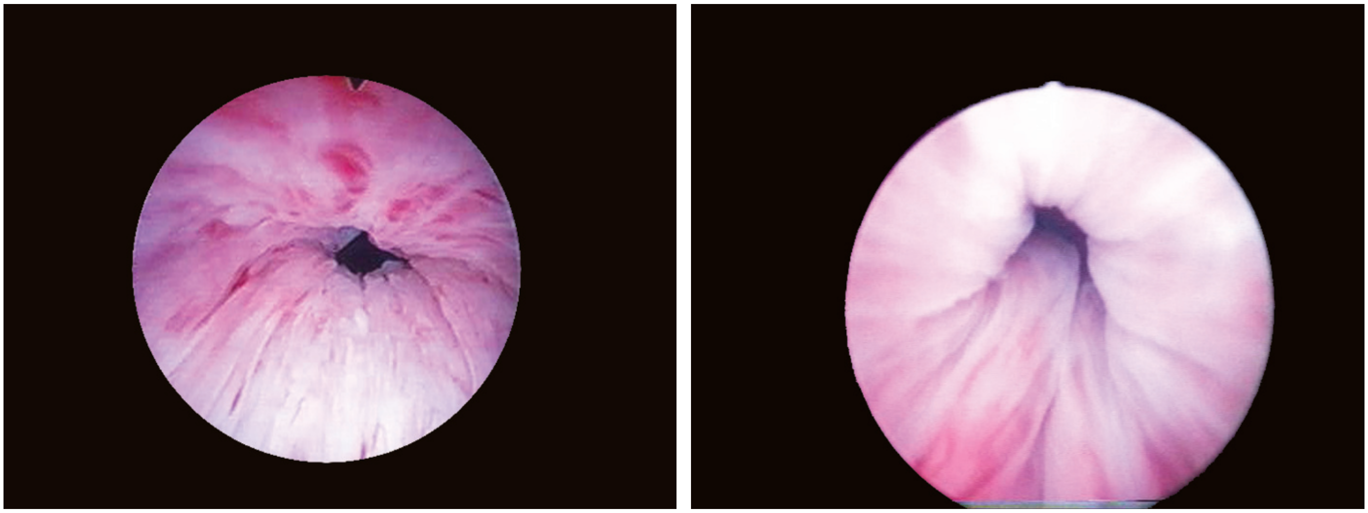

FIGURE 1.13 **Normal endoscopic appearance of the urinary bladder neck in females.**

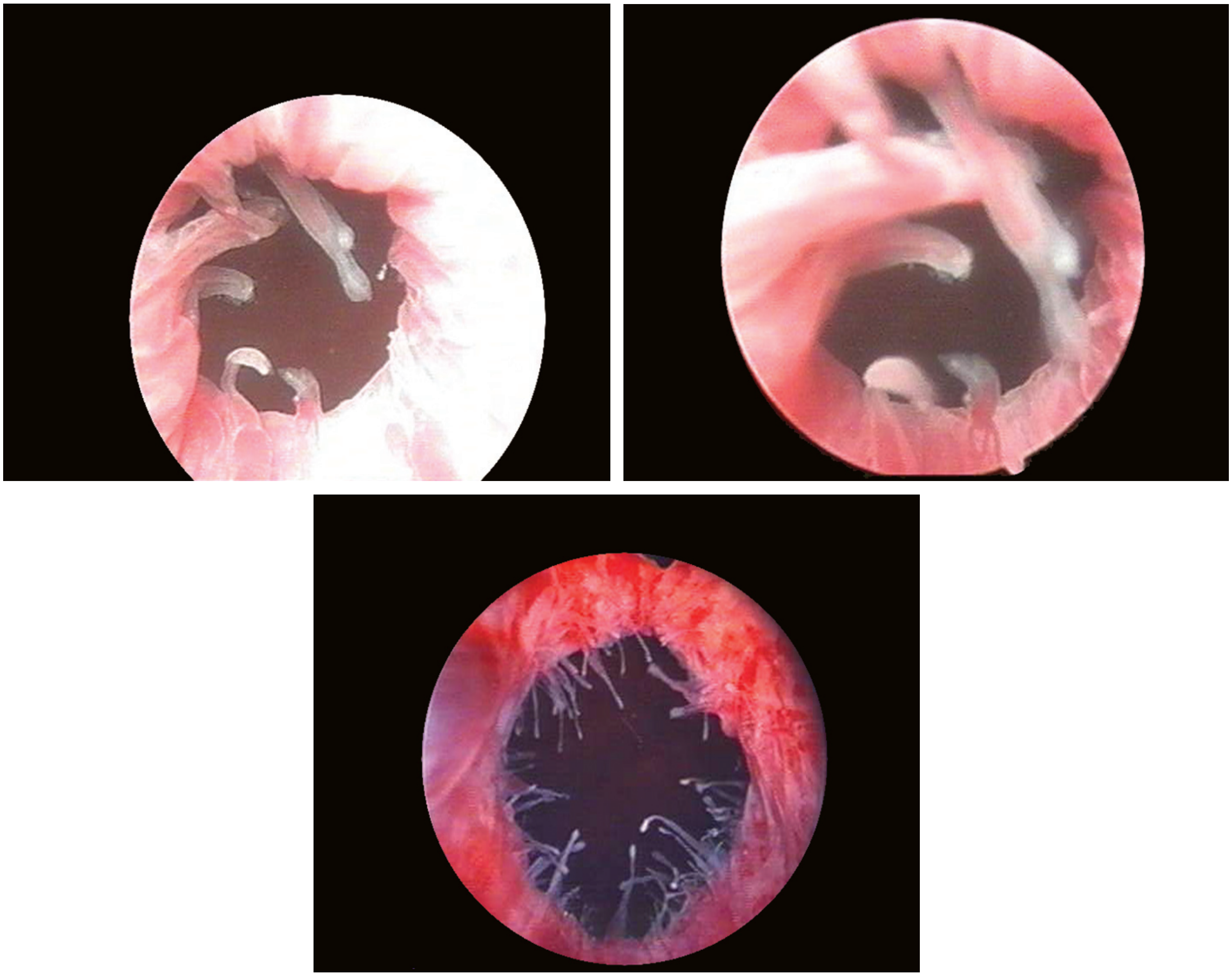

FIGURE 1.14 **Inflammatory pseudopolypoid formations of the urinary bladder neck.**

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CHAPTER

2

Optical Internal Urethrotomy in Males

Petrişor Geavlete, Răzvan Mulţescu, Mihai Drăguţescu, Dragoş Georgescu, Bogdan Geavlete

2.1 HISTORY

Urethral strictures have been a well-known pathology ever since antiquity. Historically, urethral dilation was the first documented treatment for this pathology. Wooden tubes were used for urethral calibration in ancient Egypt (Pansadoro and Emiliozzi, 1998). These primitive urologic "procedures" were initially performed due to the accessibility of the urethra (or at least its penile segment) and to the assumption, often true, that removal of the obstacle at this level may improve symptoms of patients who could not urinate. Beginning in the nineteenth century, an important diversification of these dilators is recorded, such as Philips or Benique type dilators. Benique also proposed a calibration scale for these instruments, one Benique unit being equal to 1/6 mm.

The first description of a "blind" urethrotomy belongs to Oribase from Pergam (326–403 AD), the personal doctor of the Roman emperor Julian the Apostate, who used an elongated stiletto for his patient. Subsequently, many types of urethrotomes and urethrotomies were imagined but none became available for everyday practice.

In 1854, Maisonneuve invented a flexible urethrotome made from a guiding bougie and a dorsally oriented blade (Fig. 2.1) that was more practical than its predecessors (both due to its design and to its caliber) (Schultheiss et al., 1999). In 1870, Otis developed the divulsor urethrotome with the same name. This was further modified by Mauermayer, making the two rods remain parallel no matter how wide the instrument was opened. In this form, the Otis–Mauermayer urethrotome is still largely used at the beginning of many endoscopic procedures performed on the lower urinary tract, in order to prevent meatal stenoses and strictures of the distal urethra.

The first visual guided internal urethrotomy was performed in 1865 by Desormeaux, using a fine stiletto externalized through a side slot of the sheath of the urethroscope. In 1892, Oberlander created a urethrotome with an incorporated light source and a separate channel for inserting the knives used for incisions (Brandes and Heyns, 2008).

Modern optical internal urethrotomy was developed by Helmstein (1964), who modified the classical technique of blind urethrotomy. However, this procedure was only performed for the first time in 1972, at Nurnberg, by Sachse (1974). Although optical urethrotomy was initially received with great enthusiasm, it soon became a subject of controversy regarding long-term results. This led to a search for methods to improve the efficacy of this procedure.

In 1978, Pattersen developed for the first time a hybrid between endoscopic urethrotomy and open urethroplasty. During this intervention, he applied a split skin graft through the urethra on the denuded area that remained after the incision (Pettersson et al., 1978).

2.2 GENERALITIES

A urethral stricture is the intrinsic and permanent narrowing of the caliber of the urethral lumen as a consequence of very different causes. The disease was described in ancient Greece, where scripts were discovered describing urinary bladder drainage using different catheters. Urethral strictures may be:

- congenital
- acquired

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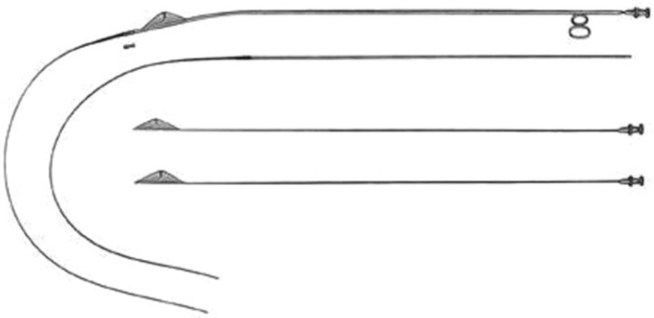


FIGURE 2.1 **The Maisonneuve urethrotome.**

Congenital strictures are due to an abnormal fusion between the anterior and posterior urethra, are short, and not associated with inflammatory phenomena.

Acquired strictures are a consequence of inflammatory, ischaemic, or traumatic factors, which determine injury of the anterior urethra and, eventually, of the corpus spongiosum, with development of scar tissue at this level.

Depending on the site where they occur, strictures are divided into strictures of the:

- posterior urethra
  - prostatic urethra
  - membranous urethra
- anterior urethra
  - bulbar
  - penile
  - fossa navicularis
  - urethral meatus

The term urethral stricture usually refers to the narrowing of the anterior segment. Strictures of the posterior urethra are most often represented by sclerosis of the bladder neck.

Devine et al. (1992) classified urethral strictures into six categories, depending on the depth of the pathological process and the involvement of the corpus spongiosum:

A – mucosal fold
B – diaphragm, without involving the corpus spongiosum
C – involvement of the entire thickness of the urethral wall, without inflammation of the corpus spongiosum
D – involvement of the entire thickness of the urethral wall and spongiofibrosis
E – inflammation and fibrosis, which extend beyond the corpus spongiosum
F – complex stricture, with urethral fistulas

Another classification divides urethral strictures into:

- primary
- secondary, relapsed

All these classifications are important for choosing the best therapeutic alternative, as well as for predicting the success rate of the procedure.

Treatment of urethral strictures is complex and difficult, requiring a delicate balance between the efficacy and the aggressiveness of the procedure, always taking into account the risk of relapse as well as the impact of the disease and its treatment upon quality of life.

Optical urethrotomy is an endoscopic technique based on tissue regeneration, a concept very similar to Davis' intubated ureterotomy, which justifies endopyelotomy or endoureterotomy.

The procedure is based on creating an incision of the urethral wall under visual guidance, an incision that is finally covered by proliferation of the neighboring mucosa. From the beginning, this method was considered to be very interesting because it is much safer than "blind" urethrotomies and allows for the control of the position where the incision of the urethral wall is performed. It is also preferred to urethral dilations, in which ruptures of the urethral wall are unpredictable. Unfortunately, the incision may initiate additional spongiofibrosis, a process that carries a negative impact on the long-term outcome.

Different strategies have been evaluated for improving this method, due to the controversial efficacy of the procedure. These include defining the criteria for patient selection, development of guidance and control techniques for proper incisions, hybrid procedures with open surgery, improvement of postoperative results, etc.

2.3 INDICATIONS

Urethroplasty is currently considered by many authors to be the treatment of choice in the management of urethral strictures. Over the last few years, the number of endoscopic procedures (Otis urethrotomy, optical internal urethrotomy) has decreased, due to the modest results following therapy of complex strictures.

However, optical internal urethrotomy has some clear advantages, being a simple procedure that can be performed even under local anesthesia or as an outpatient. The method consists of urethral recalibration by incision or ablation of the fibrous tissue, followed by prevention of the wound retracting until its complete epithelialization.

In a series of selected cases, urethroplasty represents an excessive treatment, since internal urethrotomy can solve the problem. Position, length, and degree of the spongiofibrosis influence the results of the procedure, giving an idea about which treatment is appropriate for each patient.

Thus, endoscopic interventions are indicated especially for the initial treatment of simple, uncomplicated urethral strictures; if these procedures fail, open surgery is then indicated. Endourological therapy is indicated in superficial strictures (types A, B, or C), although the risk of relapse is relatively high (Amuleke et al., 2007). Single strictures of the urethral meatus or of the bulbar urethra, shorter than 1 cm and relatively large (15F or higher lumen), are associated with high success rates of urethrotomy (Fig. 2.2), and this is the intervention indicated for these kinds of strictures (Leyh and Paul, 2005).

In case of relapse (Fig. 2.3), another internal urethrotomy can be recommended if the restenosis occurred later than 6 months after the first procedure. Relapse after less than 3 months or at least three internal urethrotomies in the past are negative predictive factors for the success of endoscopic procedures, and urethroplasty is indicated in these patients. Iterative optical urethrotomies associated with urethral dilations are indicated in patients with severe comorbidities or in those with a low life expectancy, as well as in patients with unsuccessful urethroplasties in the past (Naudé and Heyns, 2005).

When considering the costs of different types of surgical management of urethral strictures with lengths of 1–2 cm, Wright and coworkers recommend an optical internal urethrotomy before urethroplasty as the most cost-efficient approach.

Urethroplasty as primary therapy presented a favorable cost-efficiency ratio only in patients with strictures in whom optical urethrotomy has an expected success rate of at least 35% (Wright et al., 2006).

Urethroplasty is the first therapeutic option in complicated strictures (long, multiple, complete, types D, E, or F, etc.) or after failure of minimally invasive treatment of simple ones (Amuleke et al., 2007). However, failure of repeated urethroplasties after iterative urethrotomies may have a mutilating effect on the patient, with severe anatomical and

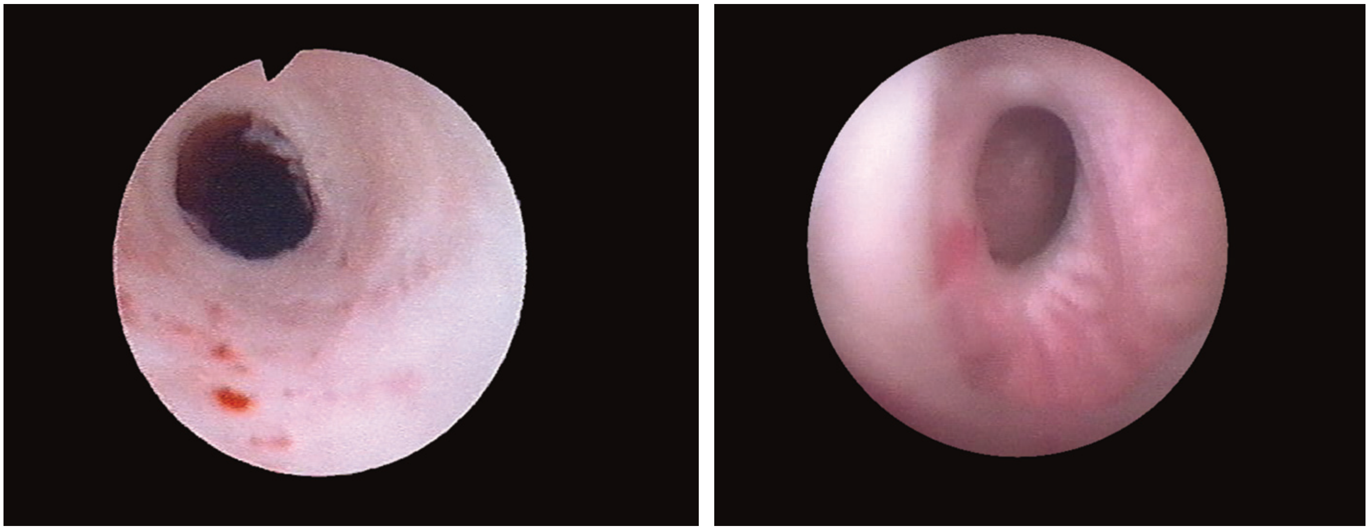


FIGURE 2.2 **Single, relatively large urethral strictures.**

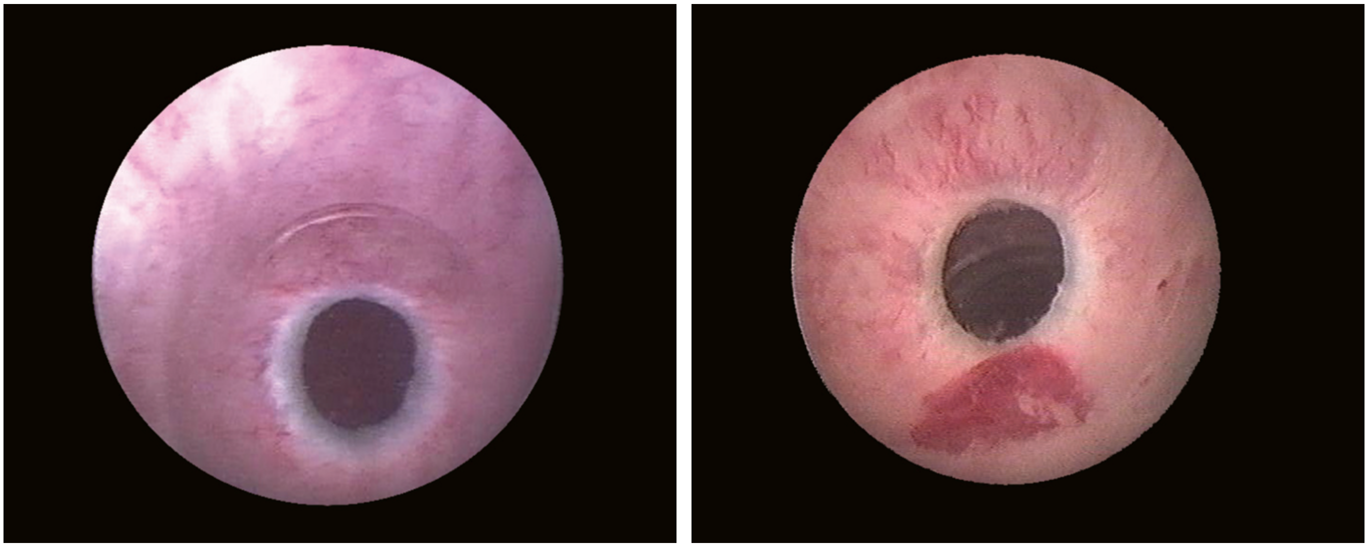


FIGURE 2.3 **Relapsing urethral strictures.**

functional consequences, requiring permanent urethro-vesical catheterization or suprapubic urinary derivations. This is why the first therapeutic option must be carefully chosen, taking into consideration the particularities of each case.

Purulent urethritis and periurethral abscesses are absolute contraindications for the endourological treatment of urethral strictures. Blood clotting disorders and urinary tract infections are relative contraindications. In these cases, correction of the clotting disorders or antibiotic therapy must precede the endoscopic intervention.

2.4 INSTRUMENTS

2.4.1 Otis Urethrotome

The Otis urethrotome allows for "blind" urethral incisions, without visual guidance.

The device consists of two metallic rods united by multiple jointed crossbars. The distance between these two metallic rods is variable, adjusted with a revolving accessory and is verified on a scale graded in F.

The upper rod has an external centered groove through which a blade (extended with a metallic shaft) slides. By moving this shaft back and forth, the blade is either completely buried inside the centered groove (the insertion position of the Otis urethrotome) or exteriorized by 2 mm (the incision position) (Fig. 2.4).

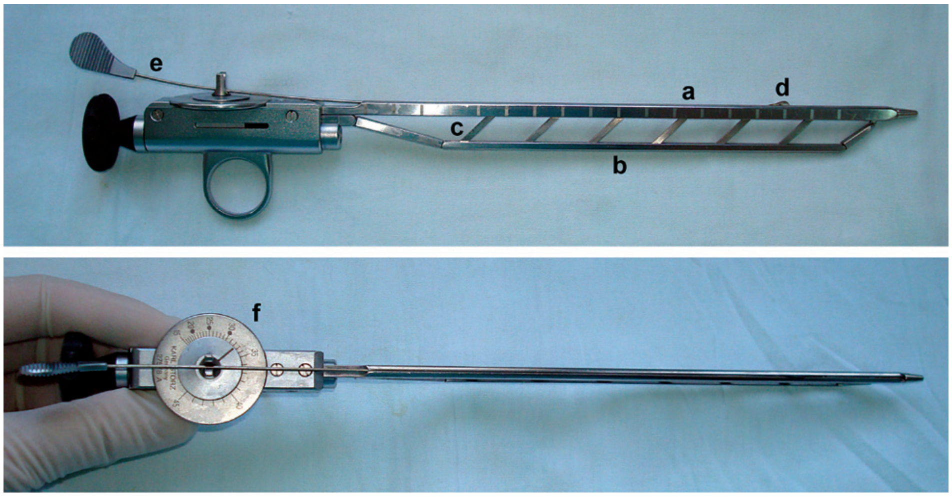


FIGURE 2.4 **The components of the Otis urethrotome.** Two metallic rods (a, b) united through multiple crossbars (c), the cutting blade (d) extended with a shaft with a handle (e), and the scale graded in F (f).

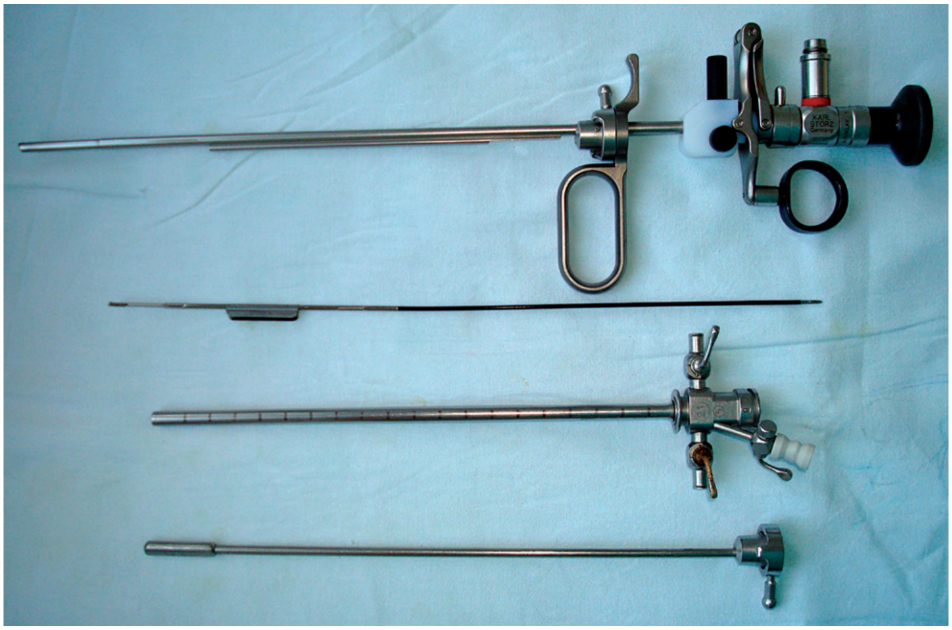


FIGURE 2.5 The components of the Sachse urethrotome.

2.4.2 Sachse Urethrotome

The Sachse urethrotome has an external configuration similar to that of a standard urethrocystoscope, consisting in a rigid optical system, a sliding piece and an external sheath (which may have a working channel) (Fig. 2.5).

A cold knife with different shapes (straight, hook, meniscal, etc.) is adapted to the sliding piece, and can be exteriorized or enclosed inside the sheath (Fig. 2.6). In the passive position of the sliding piece, the knife is completely hidden inside the sheath.

2.4.3 Electrosurgical Devices

Electrosurgical devices have a power generator (Fig. 2.7) and electrodes.

In the case of bipolar power devices, a steam sphere is generated at the distal edge of the electrodes. The high-frequency energy is released through a saline solution between the two electrodes located at the tip of the device. A thin layer of this solution is converted into plasma, which contains electrically loaded particles that will disintegrate the tissue

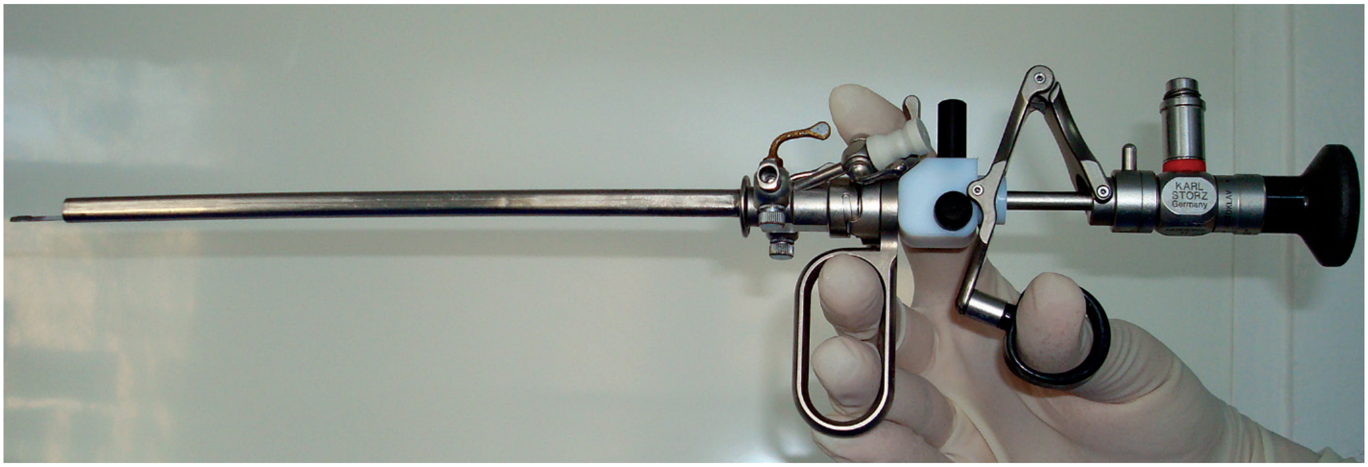


FIGURE 2.6 Operation of the sliding piece, with externalization of the cutting knife.

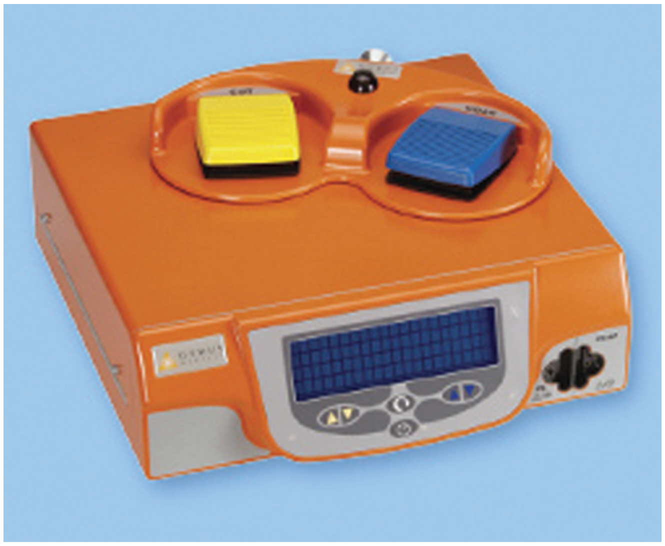


FIGURE 2.7 **The PK "SuperPulse" 110–220 V, 60 Hz generator of bipolar power.**

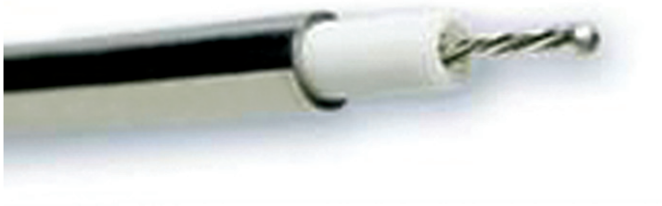


FIGURE 2.8 **The PK Plasma-Cut electrode.**

through molecular dissociation. This kind of vaporization does not increase the temperature at the site where it is applied (so-called "cold vaporization"), so it is not accompanied by extensive thermal injuries of the neighboring tissues (Alschibaja et al., 2006; Rassweiler et al., 2007).

Different types of electrodes used together with bipolar power generators have been developed for the treatment of urethral strictures. Their design depends on the type of tissue on which they will be applied. Plasma-Cut™ (Fig. 2.8) has a plaited, thinner distal tip and is used for the incision and vaporization of less dense fibrous tissue. The Plasma-Cise™ electrode (Fig. 2.9) has an arched distal tip, and is indicated in the removal of the more dense and rich fibrous tissue seen in urethral strictures and in sclerosis of the bladder neck.

2.4.4 Lasers

Currently, instead of a cold knife, different types of lasers can be used for the incision of the stricture: argon, Nd:YAG, Ho:YAG, diode, or KTP (Geavlete et al., 2008).

These have different penetrability and safety characteristics that will be discussed thoroughly during the next sections.

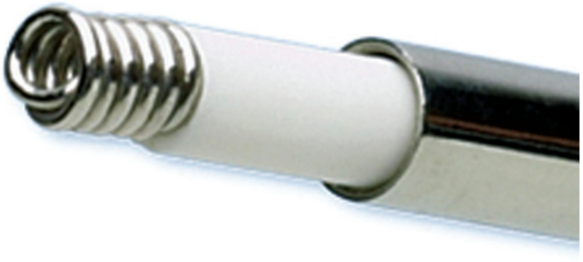


FIGURE 2.9 **The PK Plasma-Cise electrode.**

2.5 TECHNIQUES

2.5.1 Anesthesia

Optical internal urethrotomy is usually performed under spinal or general anesthesia.

In patients with short urethral strictures, endoscopic procedures may also be performed under local anesthesia using a lidocaine gel instilled inside the urethra (Munks et al., 2010). Thus, Altinova and Turkan (2007) report only mild pain in 96% of patients with urethral strictures shorter than 2 cm, treated by optical internal urethrotomy under local anesthesia using 1% lidocaine.

Other different types of local anesthesia have been proposed in order to perform urethrotomy in simpler anesthetic conditions and to reduce the costs of the procedures. Ye and Rong-gui suggest injection of 1% lidocaine inside the corpus spongiosum. However, although all the procedures were completed, the authors report pain in some cases, especially during incision of the urethral segment above the stricture. A possible explanation for this phenomenon could be a lower penetrability of the lidocaine through the scar tissue and in the corpus spongiosum above the stricture (Ye and Rong-gui, 2002).

A potential problem associated with the injection of lidocaine into the corpus spongiosum is its systemic toxicity, due to the fact that the plasma levels achieved are similar to those reached after intravenous administration. The adverse events of this phenomenon occur especially following the rapid instillation of lidocaine or in patients with liver failure, hypoproteinemia, or acidosis (Feldman, 1994).

To avoid these adverse events, Al-Hunayan and coworkers proposed a new type of anesthesia for the endoscopic treatment of short urethral strictures: transperineal urethro-sphincterian block. This discontinues the activity of the sensitive and motor nerves of the anterior urethra and of the external urethral sphincter through transperineal injection of 1% lidocaine, 1.5 cm from the anal sphincter. In one pilot study, 92% of the 24 patients with a single stricture shorter than 1 cm were satisfied with the intraoperative comfort obtained with this type of anesthesia (Al-Hunayan et al., 2008).

The use of local or locoregional anesthesia may prove to be essential in the treatment of urethral strictures in patients with important comorbidities, and this is one of the main advantages of endoscopic procedures compared with urethroplasty. Moreover, a minimal anesthesia also contributes to the efficacy of the intervention, with an acceptable price of the procedure.

2.5.2 Patient Positioning

Urethrotomy is performed with the patient in the standard position for lithotomy, with the proper decontamination of the genitalia, perineum, and lower abdomen. Sterile fields will cover the lower limbs, perineum, and abdomen, allowing access to the penis.

2.5.3 Urethrotome Insertion

The penis is pushed forward and upward by pulling the glans in order to reduce the urethral angles. The urethrotome is inserted directly, under visual guidance, after a lubricating gel is instilled into the urethra. In order to avoid any iatrogenic injury, the endoscope is manipulated with the cutting blade retracted inside the sheath. An alternative is to insert the external sheath into the distal urethra using a blind mandrin. The mandrin is then pulled off and the optical part of the device is assembled (eventually together with the gliding system containing the cold blade). The endoscope will slowly be moved forward until the stricture is observed. The maneuver is facilitated by the urethral distension caused by the flow of the washing solution.

2.5.4 Stricture Catheterization

For catheterization of tight strictures, a wire guide (Fig. 2.10) or a 3F catheter are inserted along the working channel of the urethrotome. They have the role of guiding the direction of the incision, respecting the trajectory of the urethral path.

2.5.5 Incision

Different other technical alternatives have been described for urethrotomy, with different positions, types, and methods of guidance. All these parameters are described as follows. While some of these techniques were developed

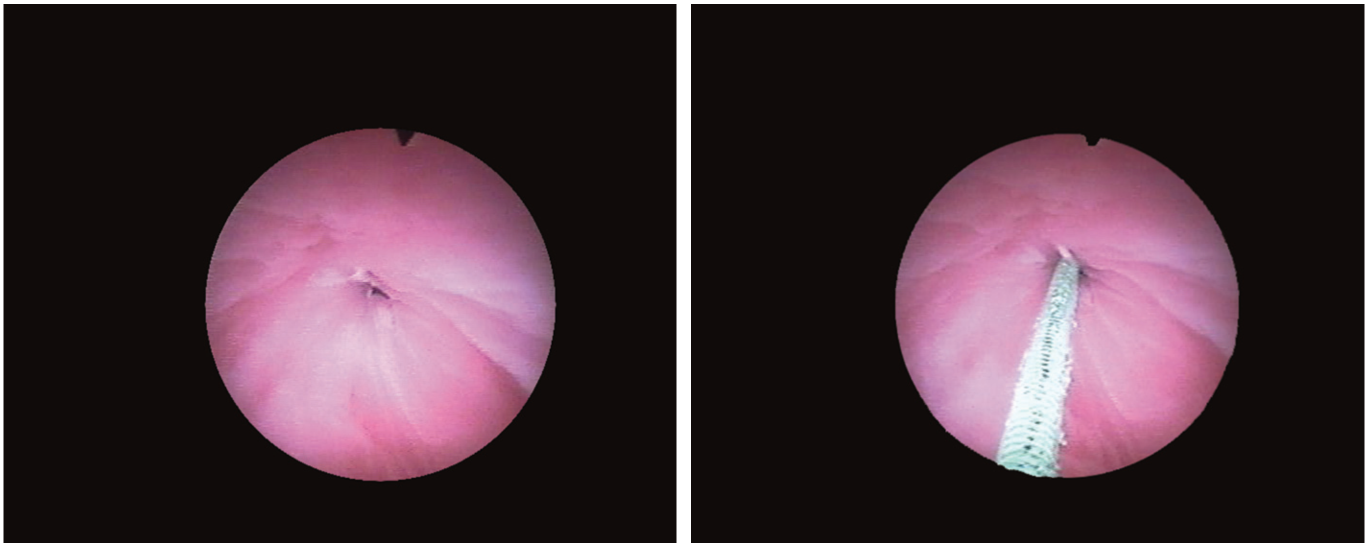


FIGURE 2.10 **Placing the wire guide at the level of a punctiform stricture.**

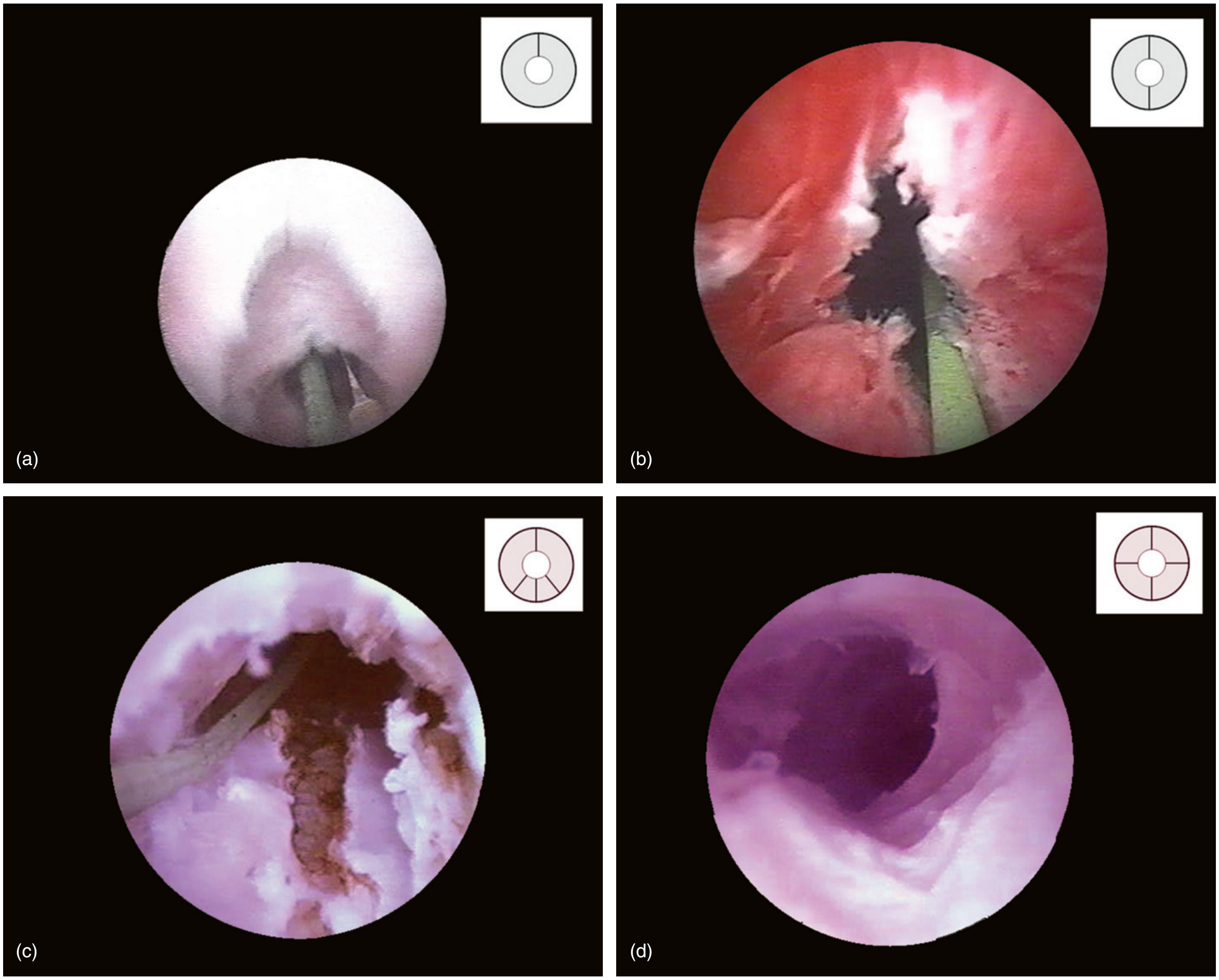


FIGURE 2.11 **Different sites of incision.** (a) 12 o'clock; (b) 6 and 12 o'clock; (c) 5, 6, 7, and 12 o'clock; and (d) 3, 6, 9, and 12 o'clock.

in order to safely perform urethrotomies in patients with complicated strictures (such as the bipolar approach), others were invented to achieve better results (e.g., ultrasound exam for determining the position of the incision). The final objective of all these alternative techniques is to obtain a urethral lumen of 24–26F at the site of the stricture.

2.5.5.1 *Position of the Incisions*

The incision(s) may be performed in different positions. In the classical technique described by Sachse (1974), the incision is performed at the 12 o'clock position, with a minimal risk of injury of the corpus cavernosum, the urethral arteries, and cavernous nerves, or for formation of fistulas or diverticula. However, the corpus spongiosum has the lowest thickness between 10 o'clock and 2 o'clock, and for this reason, deep incisions at this level may induce injuries in the neighboring structures. For this reason, some changes have been made to the original method, variants in which the incisions are performed at 10 and 2 o'clock, 12 and 6 o'clock, 2 and 6 o'clock, stellate, at 12, 3, 6, and 9 o'clock or at 10, 12, 2, and 6 o'clock (Fig. 2.11).

Choosing one type or another is usually influenced by the relations between the stenosed urethral segment and the anatomical structures mentioned earlier, as well as by the position of the fibrous callus (Fig. 2.12).

In order to achieve better results and to reduce complication rates, some authors perform the incisions after the position of spongiofibrosis is evaluated by an ultrasound exam (Geavlete et al., 2004) (Figs 2.13–2.15).

Compared with retrograde urethrography or endoscopy, ultrasound allows for an evaluation of the extension of spongiofibrosis, with a better characterization of the stenosis (Fig. 2.16) and implicitly with a better chance of choosing the optimal therapeutic alternative (Geavlete et al., 2003).

Ultrasound evaluation of a urethral stricture identifies the number, length, and position of the strictures, as well as the disposition of the fibrous tissue (Geavlete et al., 2005) (Fig. 2.17).

The technique allows for a complete incision of the callus, but without sectioning the entire corpus spongiosum, and also protects the normal urethral wall in order not to initiate new sites of spongiofibrosis (Ditonno et al., 1996; Geavlete et al., 2000; Mitterberger et al., 2007) (Figs 2.18–2.22).

Other authors recommend Doppler ultrasound for identifying the position of the urethral arteries and performing the incisions in avascular areas, in order to reduce the risk of hemorrhagic complications associated with urethrotomy (Chiou et al., 1998; Kishore et al., 2005).

2.5.5.2 *Incision Type*

2.5.5.2.1 COLD KNIFE URETHROTOMY

Cold knife urethrotomy is performed using the Sachse urethrotome. With this technique the urethrotome is used in a single block, with the knife completely externalized. To perform the incision, the knife is placed in close contact

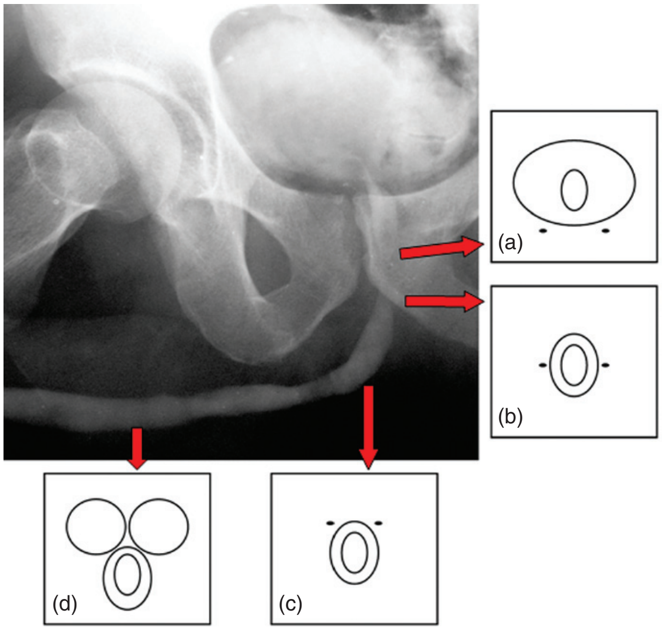
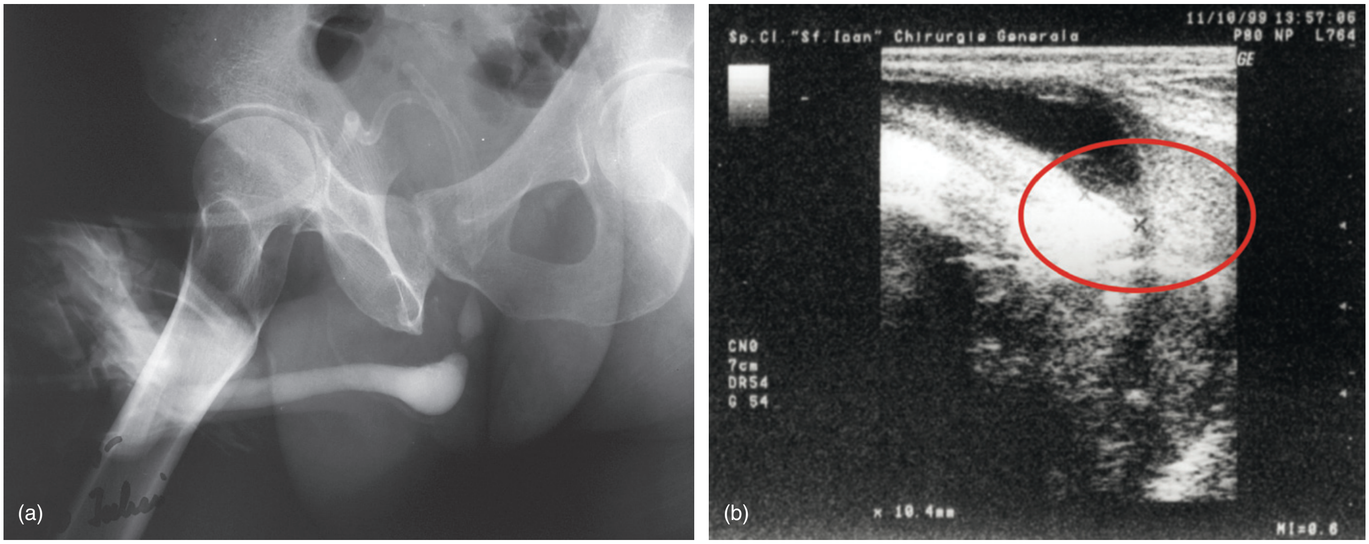


FIGURE 2.12 **Relations between the nerves and corpus cavernosum and different urethral segments.** (a) prostatic, (b) membranous, (c) bulbar, and (d) penile.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11/10/99 13:57:06
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P80 NP L764
GE
CN0
7cm
DR54
G 54
x 10.4mm
MI=0.6

FIGURE 2.13 **Stricture of the bulbar urethra (a) with spongiofibrosis at 12 and 6 o'clock seen at ultrasound exam (b).**

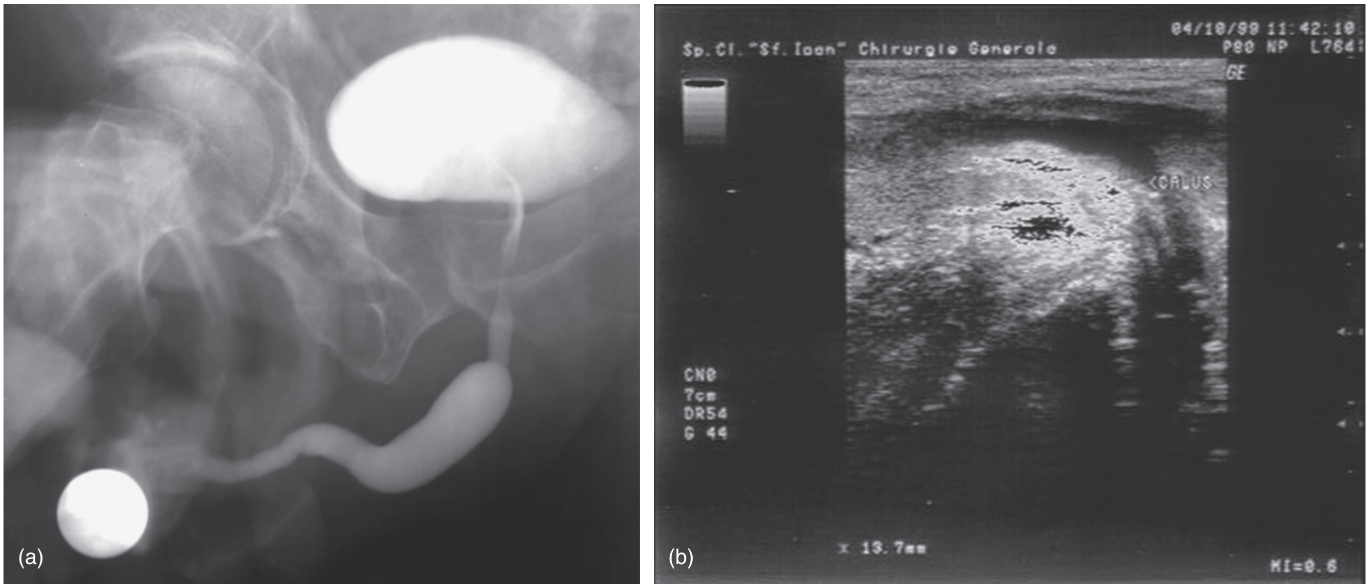
with the urethral wall where the stricture lies, followed by the movement of the distal part of the urethrotome from downward to upward in the same time with its withdrawal until the tip of the knife reaches the underlying healthy tissue.

For short, diaphragm-like strictures, a single such maneuver may be sufficient. For longer strictures, successive incisions are performed, gradually advancing up to the bladder neck until the overlying normal urethra is seen in front, allowing passage of the endoscope (Fig. 2.23).

Some variants of this technique are urethrotomy using a scalpel or an Otis urethrotome, indicated only for the incision of strictures of the urethral meatus or of the distal penile urethra.

Incision with a scalpel may be used in stenosis of the urethral meatus by guiding the blade through the groove of a probe passing the stricture. A bipolar approach may be used in complete stenosis, with visual guidance of the blade using a flexible cystoscope inserted percutaneously above the pubis and then forward into the urethra.

Incision with an Otis urethrotome is used for strictures of the distal urethra. After lubricating the urethra with gel, the urethrotome is inserted through the stricture with the blade unexposed and then it is opened up to a 25–28F caliber. Some authors recommend opening the device up to 30–45F (Calomfirescu and Voinescu, 2001).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7cm
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FIGURE 2.14 **Stricture of the bulbar urethra (a) with spongiofibrosis at 12 o'clock seen at ultrasound exam (b).**

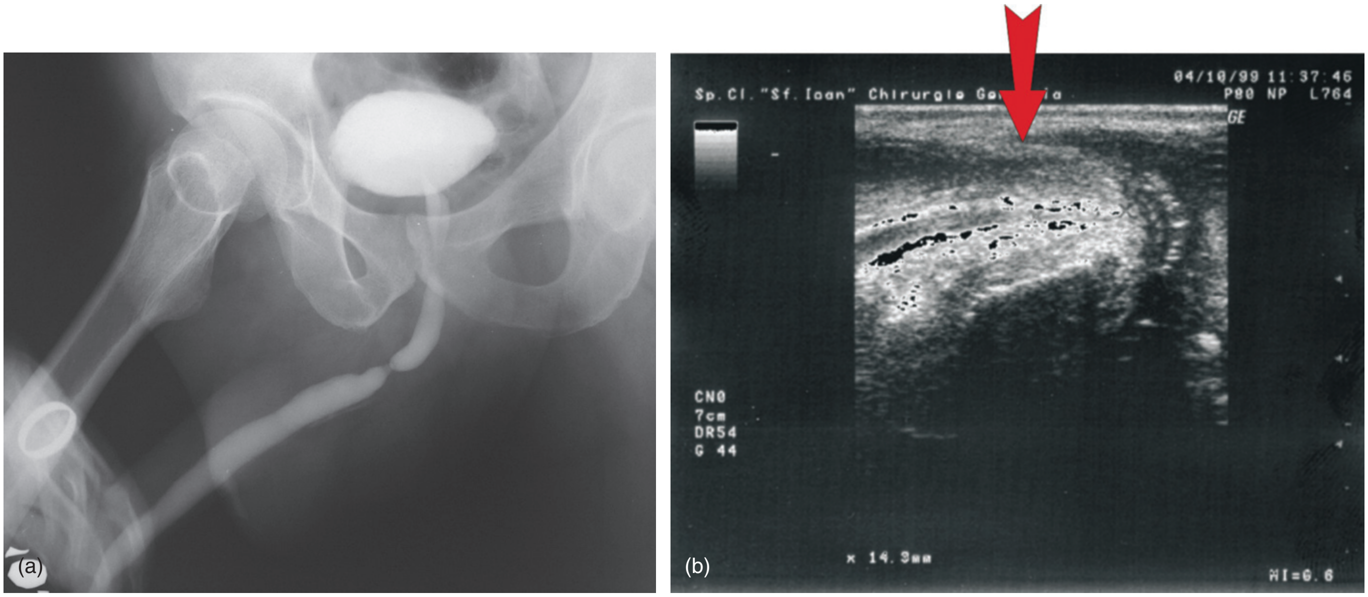
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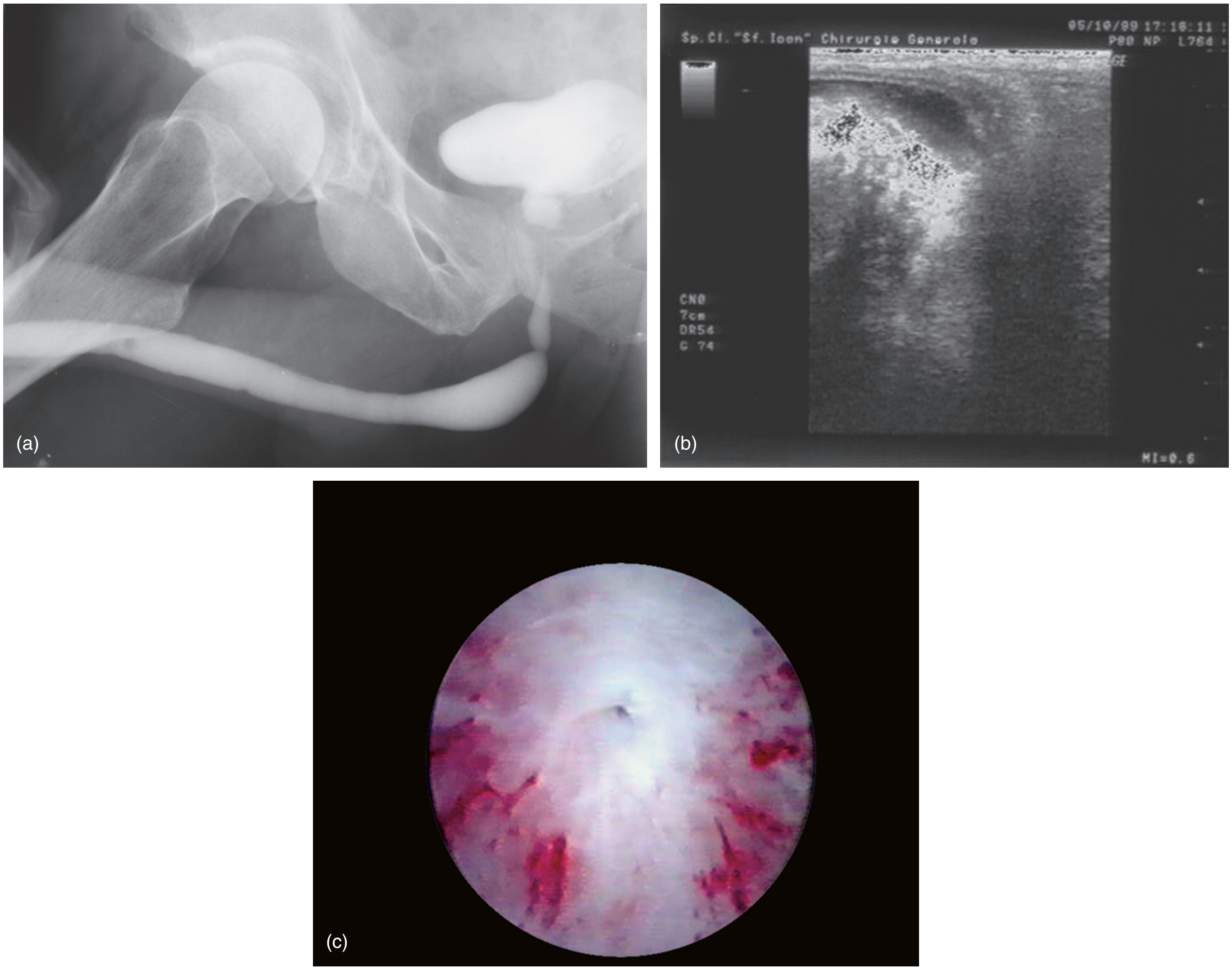
FIGURE 2.15 **Stricture of the penile urethra (postbulbar) (a) with spongiofibrosis at 12 o'clock seen at ultrasound exam (b).**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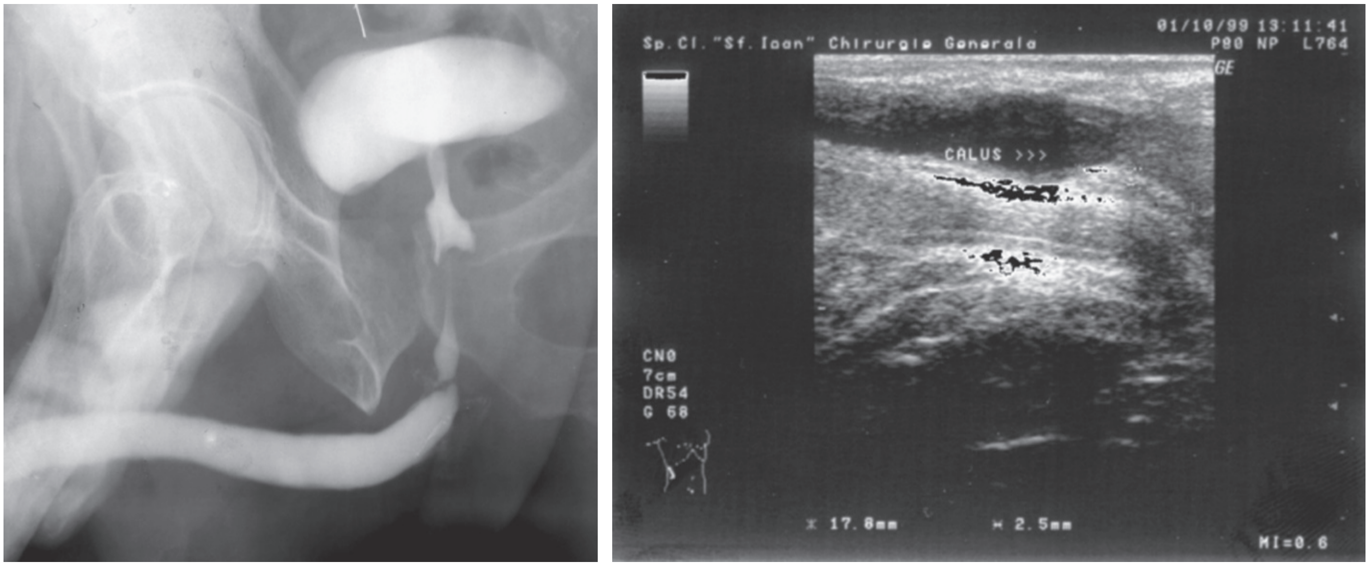
G 74
MI=0.6
(c)

FIGURE 2.16 **Comparison between aspects of a stricture of the bulbar urethra explored by (a) urethrography, (b) ultrasound (showing also the extension of spongiofibrosis), and (c) endoscopy.**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CALUS >>>
CN0
7cm
DR54
G 68
x 17.8mm
+ 2.5mm
MI=0.6

FIGURE 2.17 **Stricture of the bulbar urethra, with spongiofibrosis seen by ultrasound at 6 and 12 o'clock.**

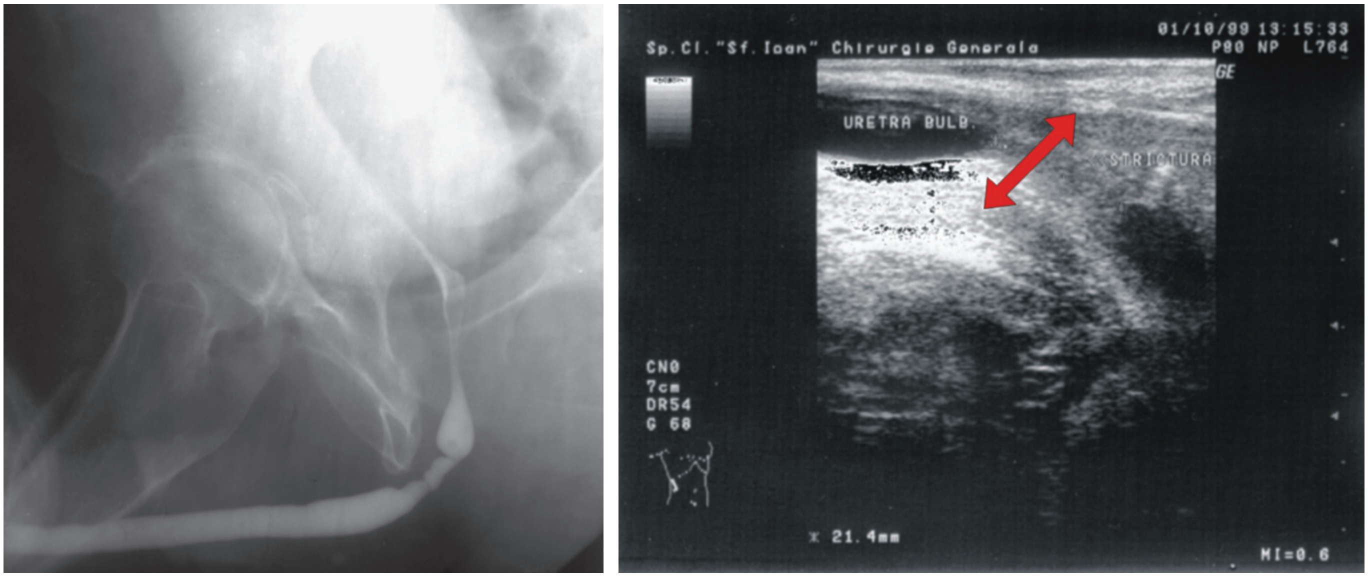
After the blade is positioned at 12 o'clock and is externalized by proximal sliding, the urethrotomy is performed by pulling back the device. One single incision is recommended, allowing for a better chance of healing of the urethral urothelium. If multiple incisions are needed, the Otis urethrotome is reinserted, opened 3–5F more, and the procedure is repeated. This type of urethrotomy is also frequently used for recalibrating the urethral meatus and the distal urethra before endoscopic resections to allow for a smooth passage of the resectoscope.

Changes to the classical technique have also been described. Carlton et al. (1994) recommends performing incisions at 5 and 7 o'clock. These incisions, without visual control, are considered to be at the border of endourology, and have a higher risk of bleeding or of iatrogenic urethral injuries compared with endoscopic techniques.

2.5.5.2.2 ELECTRICAL URETHROTOMY

Incision of the stricture may also be performed electrically, with loops or electrodes, using monopolar or bipolar power (Yang et al., 2006).

Transurethral resection of the spongiofibrosis process has also been described (Martov et al., 2007).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GE
URETRA BULB.
<<STRICTURA
CN0
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G 68
x 21.4mm
MI=0.6

FIGURE 2.18 **Stricture of the bulbar urethra, with spongiofibrosis seen at ultrasound at 6 and 12 o'clock.**

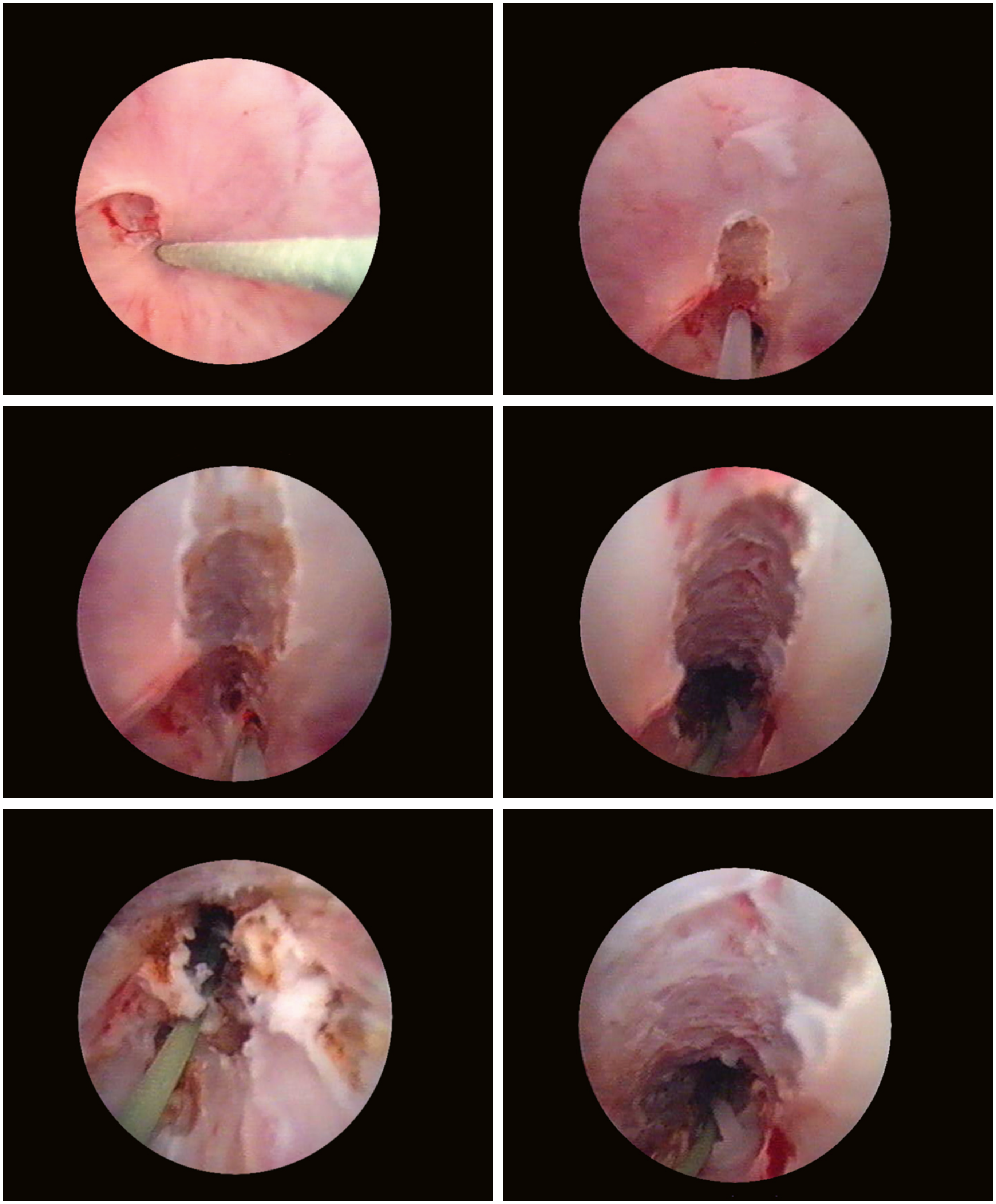

FIGURE 2.19 Laser incisions performed at 6 and 12 o’clock, according to ultrasound examination.

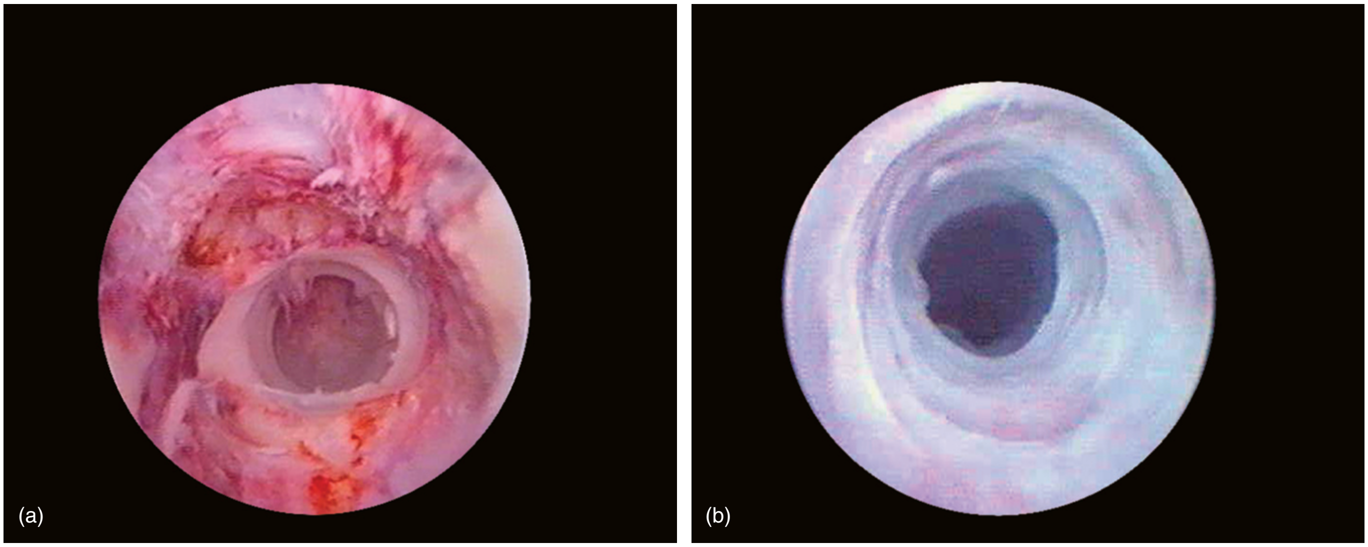

FIGURE 2.20 **A large lumen obtained: (a) at the end of the procedure and (b) after 3 months.**

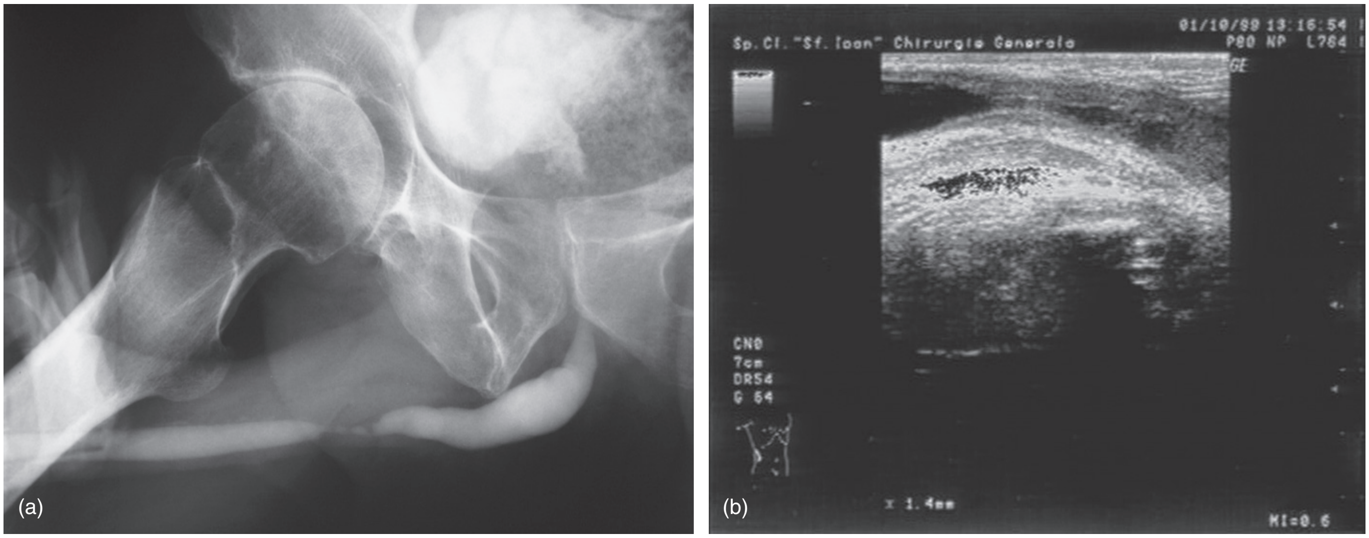

FIGURE 2.21 **Multiple strictures of the penile urethra (a), with spongiofibrosis seen on ultrasound at 12 o'clock (b).**

Guillemin et al. (1989) uses cold knife incisions at 11 and 1 o'clock, followed by resection of the fibrous tissue found in between (Fig. 2.24).

These types of urethrotomy use monopolar or bipolar resectoscopes, or simple cystoscopes in case of incisions with electrodes. Urethrotomy using a balloon with a cutting wire has been proposed, similar to the procedures used for incision of ureteropelvic junction stenoses or of vascular stenoses (Yldirim et al., 2009).

2.5.5.2.3 LASER URETHROTOMY

Laser urethrotomy uses simple 17–22F cystocopes with axial or lateral shooting fibers.

The method consists in a simple incision of the spongiofibrosis tissue, into healthy tissue, or its vaporization (Niţă et al., 2009). The procedure is similar to that performed with a cold knife, with permanent visualization of the fiber tip and successive incisions, gradually advancing to the bladder neck (Fig. 2.25).

In case of callus vaporization, an incision is initially performed at 12 o'clock, into healthy tissue, followed by circumferential ablation of the fibrous tissue. In other variants incisions are made at 11 and 1 o'clock or at 10 and

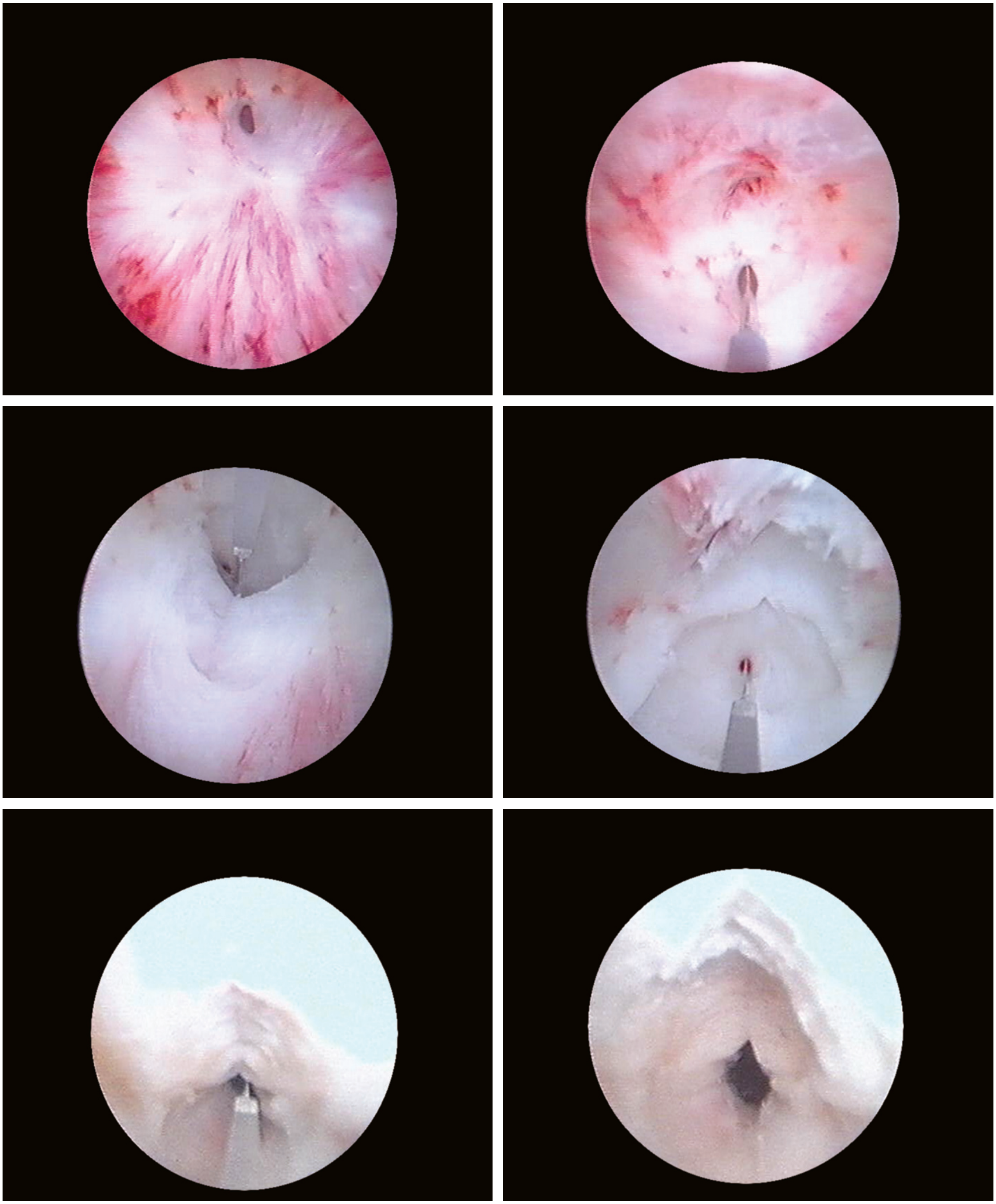

FIGURE 2.22 Gradual incisions of multiple strictures of the penile urethra with the cold knife, cutting the spongiofibrosis at 12 o'clock.

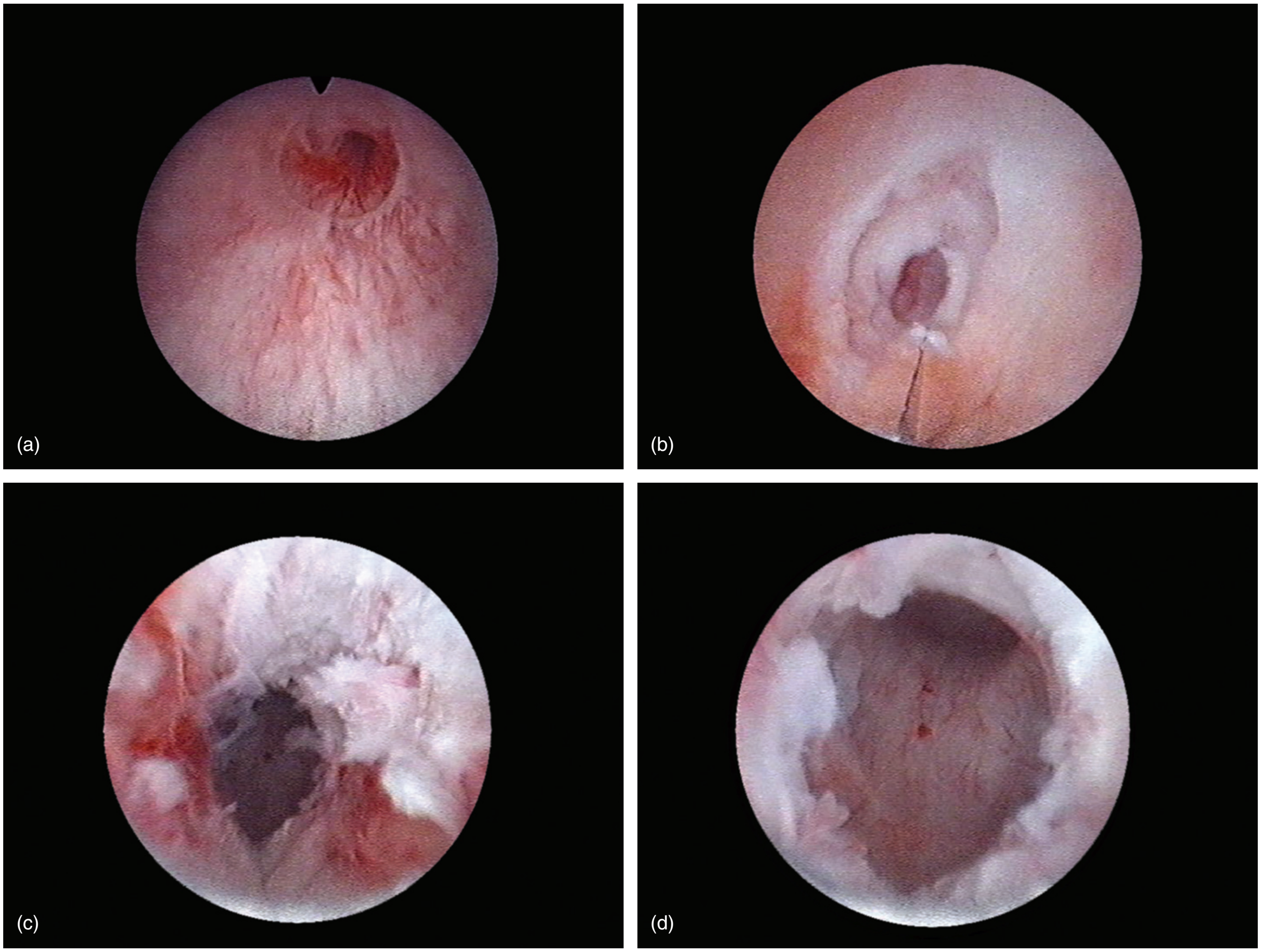

FIGURE 2.23 Stricture of the bulbar urethra (a) treated by successive incisions with a cold knife (b–d).

2 o'clock, followed by callus vaporization from the segment marked this way. Nd:YAG laser has a high tissue penetration, of 4–5 mm, and for this reason it has to be used carefully to reduce the risk of iatrogenic injuries and complications. This laser is usually applied in the contact mode, using 20–50 W of power (Gürdal et al., 2003).

The diode laser may also be used for incision of urethral strictures and possibly for vaporization of spongiofibrosis tissue (Figs 2.26–2.29). Tissue penetration is similar to the Nd:YAG laser, of 4–5 mm (Kamp et al., 2006).

The KTP laser has a tissular absorption of 0.3–1 mm, a superior accuracy of incisions, and a better safety profile compared with Nd:YAG, making it an efficient alternative in the endoscopic treatment of urethral strictures (Turek et al., 1992; Schmidlin et al., 1997). The Ho:YAG laser has a penetration of only 0.5 mm and offers the possibility for incisions or ablations through vaporization of the fibrous tissue, with minimal thermal injuries of the underlying healthy tissue. For these reasons, the Ho:YAG laser is safer and more efficient than the Nd:YAG laser (Smith et al., 1994; Matsuoka et al., 2002). Usually this laser uses 15 W energy (1200–1400 mJ with a 10–15 Hz frequency) (Kamp et al., 2006).

2.5.5.3 Guiding the Incision

2.5.5.3.1 SIMPLE, WITH VISUAL CONTROL

It is a very frequently used method, especially for short strictures with a medium or large caliber, in which the direction of the urethral lumen can be correctly identified. This way the incision is performed under a permanent visual feedback, with good control of urethrotomy depth and length (Fig. 2.30).

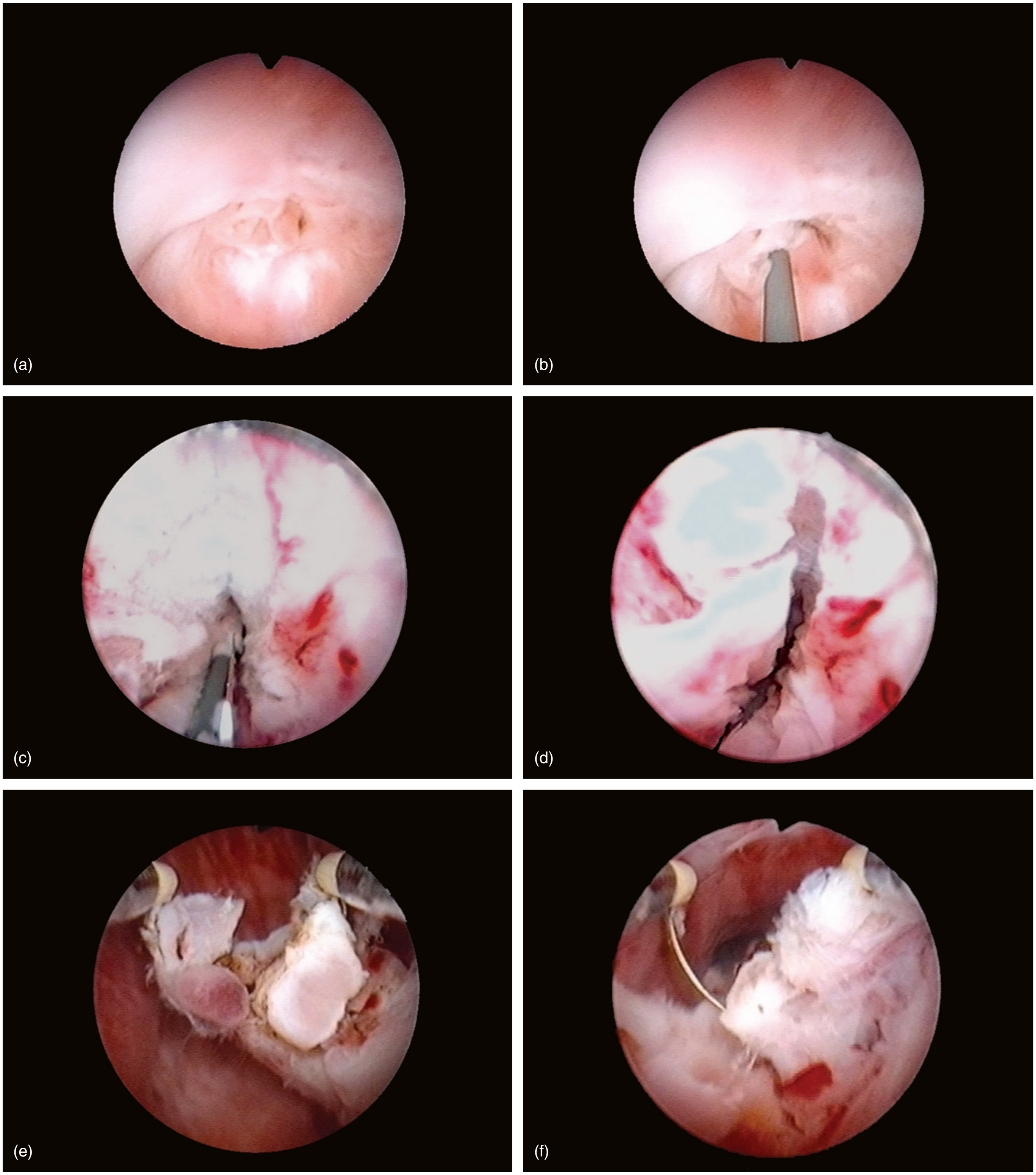

FIGURE 2.24 Relapsed punctiform urethral stricture (a, b) for which cold knife incision is performed (c, d) followed by transurethral resection of the fibrous tissue (e, f) obtaining a large lumen (g, h).

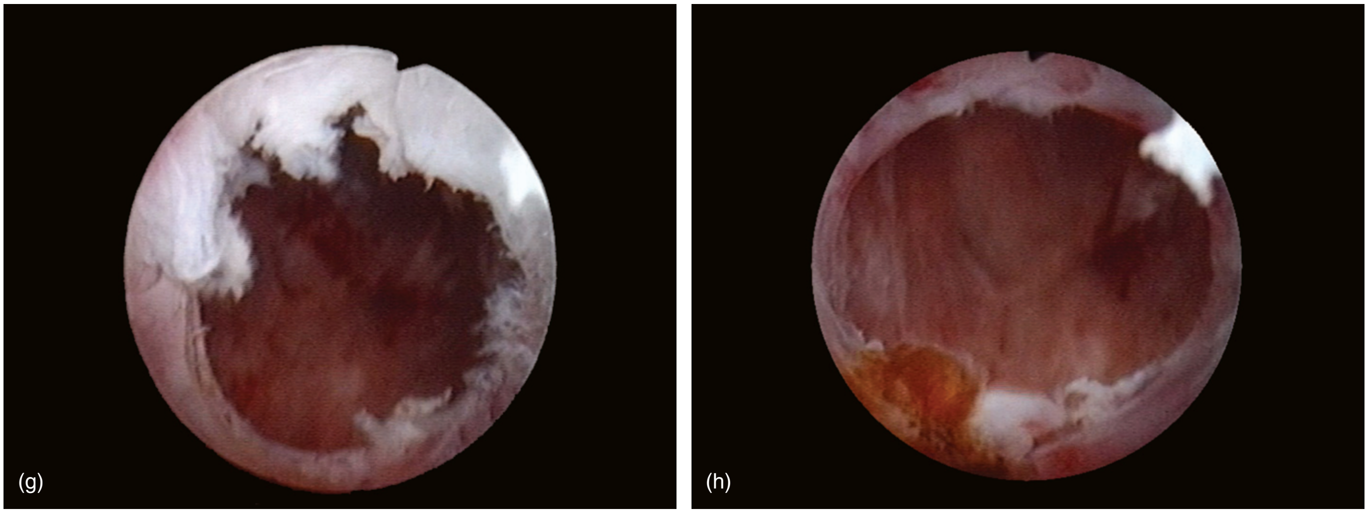

FIGURE 2.24 *(cont.)*

The depth of the incision should be ideally beyond the fibrous tissue (Fig. 2.31). For this reason, optical internal urethrotomy is indicated especially for strictures with only superficial periurethral spongiofibrosis. For strictures of the proximal bulbar urethra (Fig. 2.32), the incision must be carefully performed to avoid injuries of the striated sphincter (Fig. 2.33).

2.5.5.3.2 ON A WIRE OR ON A URETHRAL CATHETER INSERTED RETROGRADELY

This approach is used for narrow strictures, but with a lumen that can still be identified and catheterized retrogradely. The cold or laser incision is performed along the wire or catheter, following the direction of the urethral lumen (Figs 2.34 and 2.35).

2.5.5.3.3 BY BIPOLAR APPROACH

There are different types of urethrotomy by bipolar approach:

- After anterograde instillation of methylene blue.

  This technique is used especially for very tight strictures or for those associated with iatrogenic false passages, when it is very difficult or even impossible to identify the true urethral lumen. Methylene blue solution may be instilled through the cystostomy tube (if one was placed) or injected via a needle used previously for percutaneous bladder puncture. After the bladder is filled up (possibly associated with exertion of manual pressure in the suprapubic area), the methylene blue solution may color the true lumen, guiding the incision (Fig. 2.36).
- The "cut-to-the-light" or "rendezvous" technique.

  This is useful for tight strictures that cannot be catheterized, with complete obstruction of the lumen (Geavlete et al., 2007; Georgescu et al., 2009) (Fig. 2.37). Frequently, these types of strictures develop after urethral trauma. The method consists in inserting a flexible cystoscope via a suprapubic percutaneous passage, through the bladder neck and then anterogradely through the urethra up to the segment overlying the stricture (Fig. 2.38). Retrograde urethrotomy is guided toward the light of this flexible cystoscope, visible through the stricture tissue and indicating the direction of the urethra (Fig. 2.39). Incisions are performed carefully, so as not to deteriorate the flexible cystoscope, until the urethral lumen becomes large enough to allow passage of the urethrotome (Figs 2.40 and 2.41).
- Retrograde urethrotomy on a wire inserted anterogradely.

  This is an alternative to the technique described earlier. Sometimes, in very tight strictures that are impossible to be catheterized retrogradely, a guidewire can be inserted anterogradely, through the working channel of a flexible cystoscope inserted close to the stenosis.

  It is also possible to use this technique in the presence of false passages, when the true lumen cannot be identified (Figs 2.42 and 2.43). The light of the cystoscope further guides the incision, similar to the "cut-to-the-light" technique (Fig. 2.44).

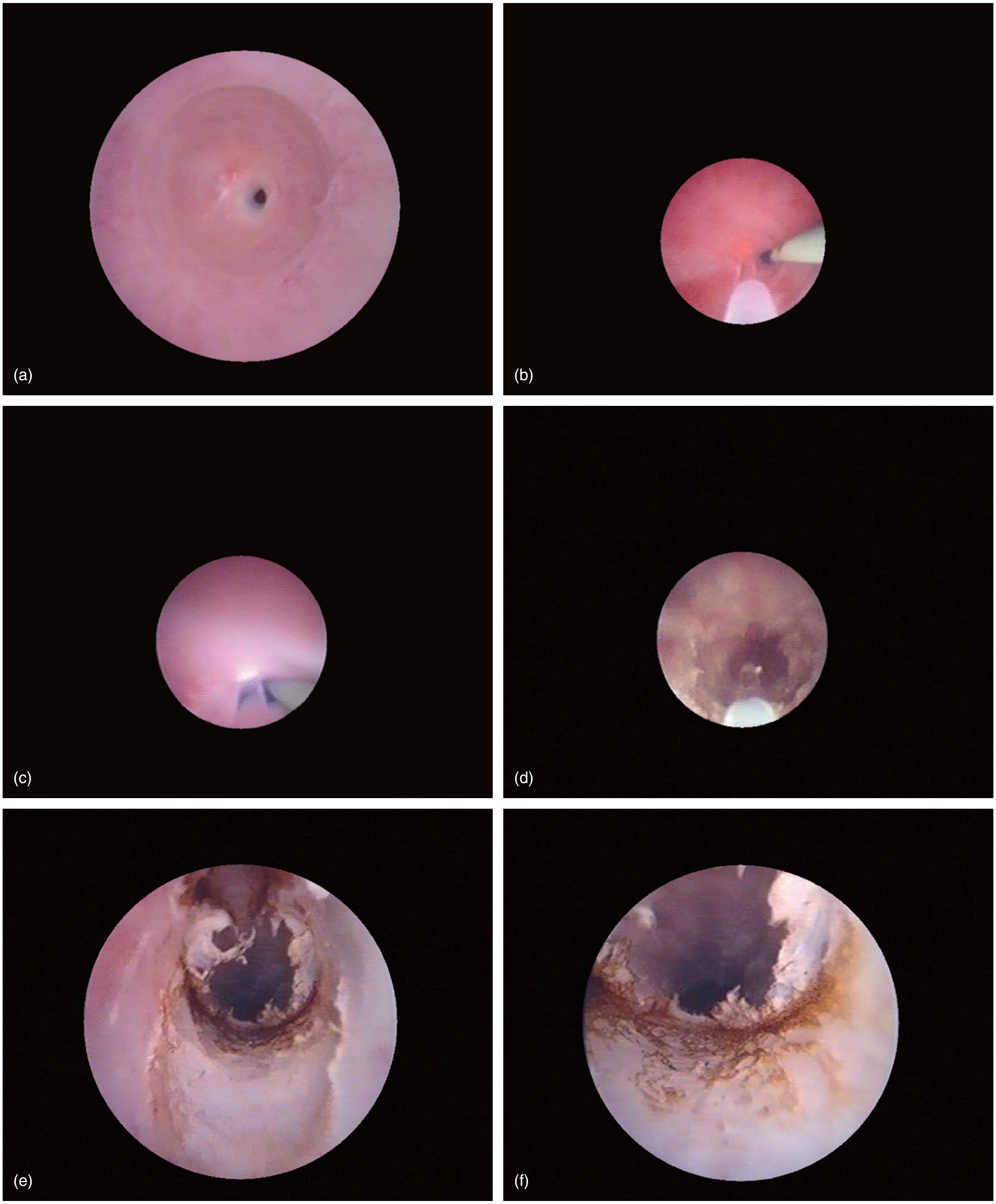

FIGURE 2.25 Punctiform stricture (a) for which gradual incisions with Nd:YAG laser are done with the fiber inserted on a ureteroscope (b–d); large lumen obtained at the end of the procedure (e, f).

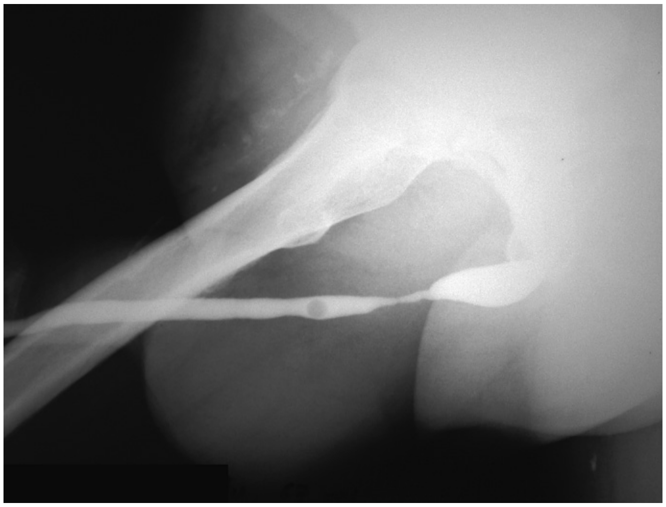

FIGURE 2.26 **Long, relapsing stricture of the postbulbar urethra.**

- Retrograde urethrotomy on a metallic dilator inserted anterogradely.

  For very short and complete strictures, retrograde urethrotomy may also be guided using a Benique metallic curved dilator. This is passed via the route of the suprapubic cystostomy, through the bladder neck and anterogradely up the urethra, until its distal tip distorts the intraluminal tissue of the stricture. The incision is done in the distorted area, until the metallic dilator is seen.
- Incision with a scalpel under anterograde visual control.

  The technique is used for complete strictures of the distal penile urethra (Fig. 2.45).

2.5.5.3.4 WITH ULTRASOUND GUIDING

Allepuz Losa et al. (1995) recommend performing the urethrotomy under transrectal real-time ultrasound guidance to check for an accurate and complete incision into healthy tissue.

Ultrasound guidance has also been recommended by some authors at the beginning of bipolar urethrotomy in patients with longer complete strictures. Transrectal ultrasound highlights the spongiofibrosis as well as the urethral lumens above and beneath the stricture, and guides the advancing of the cold knife along the correct direction. When the length of the stricture is sufficiently reduced for the light from the flexible cystoscope inserted anterogradely to be seen, the ultrasound guidance is changed with the “cut-to-the-light” technique (Chuang et al., 1994; McVary and Grayhack, 1991; Calomfirescu and Voinescu, 2001).

2.5.6 Treatment of Associated Lesions

Urethral strictures are frequently associated with other lesions: stones, false passages, etc. Stones migrating into the urethra may be embedded inside the stenosis. In these cases, after urethrotomy, ballistic, electrohydraulic, pneumatic, or laser lithotripsy is performed, followed by extraction of the fragments (Fig. 2.46). False passages are iatrogenic, after attempts of bladder catheterization via the urethra, usually complicating tight strictures (Fig. 2.47).

Urethro-vesical catheter indwelling after internal urethrotomy is the only treatment needed for small false passages (Fig. 2.48) and no other surgical procedures are necessary. For larger false passages, the septum between these and the urethral lumen is destroyed by incision (Figs 2.49 and 2.50). Sometimes old, epithelialized, bulky false passages are identified later on after the moment in time when they appear (Fig. 2.51). These can also be destroyed using the techniques mentioned earlier (Fig. 2.52).

2.5.7 Biopsies

Multiple biopsies with biopsy forceps or extractors should be done in patients with strictures harboring lesions with suspected malignant transformation or in patients with a history of urothelial cell carcinoma (Fig. 2.53). When resection of the fibrous callus is performed, the fragments are studied by a pathologist.

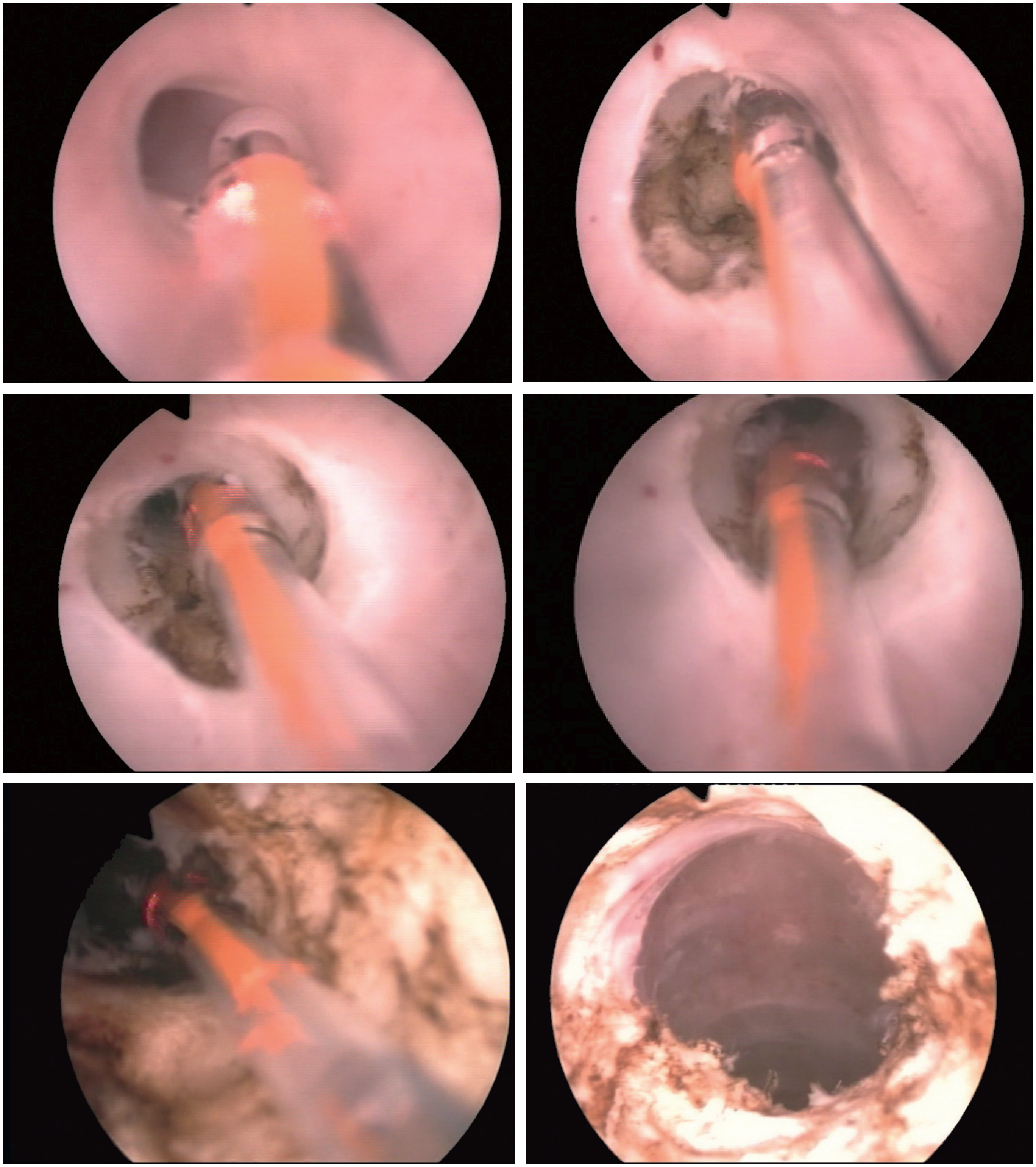

FIGURE 2.27 Progressive, circumferential vaporization of spongiofibrosis with diode laser, until an access is obtained through the stricture.

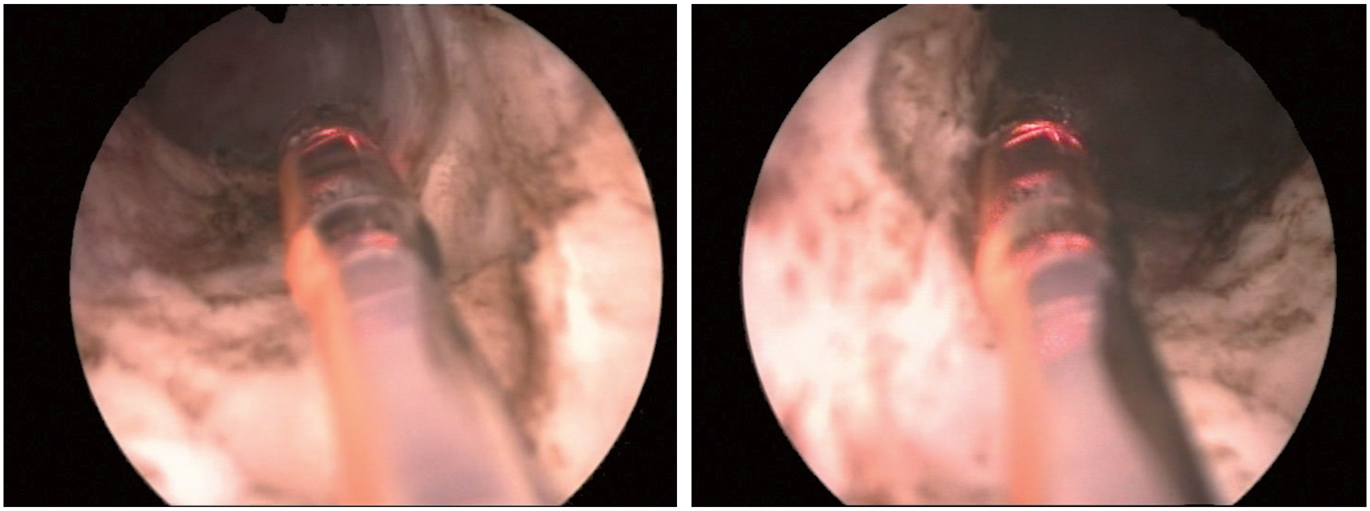

FIGURE 2.28 Vaporization of the entire spongiofibrosis process into healthy tissue.

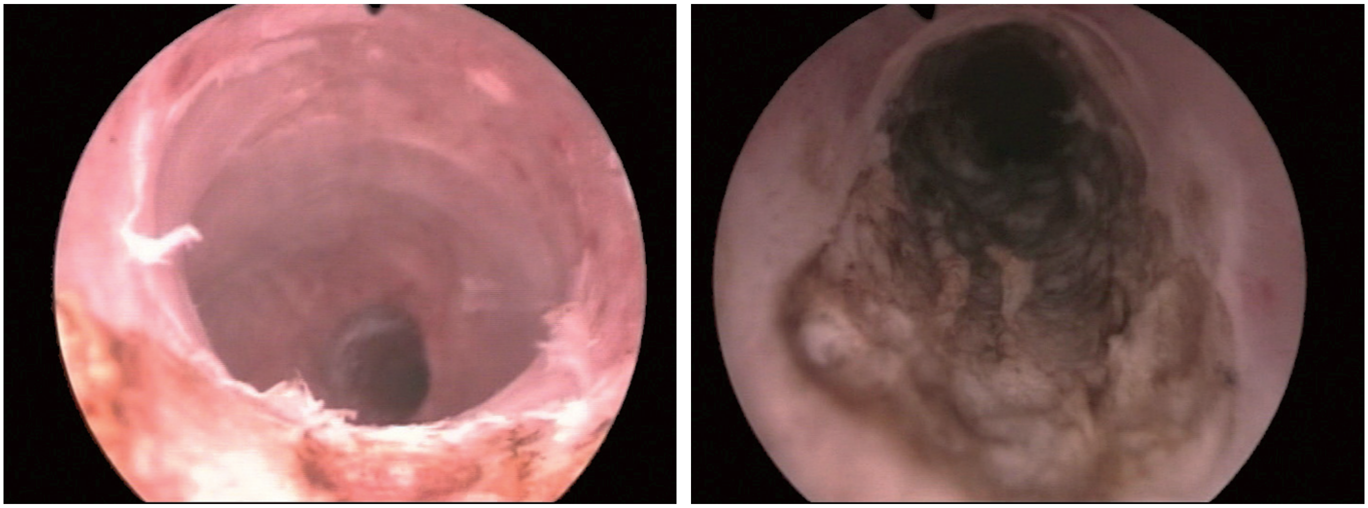

FIGURE 2.29 Large urethral lumen at the end of the procedure.

2.5.8 Cystoscopy

The bladder is examined after passing the stricture (using the same urethrotome) in order to identify other potential associated lesions (stones, bladder tumors, etc.).

2.5.9 Urethral Inspection

A last urethral inspection is done when the urethrotome is pulled out, especially at the incision site. The "hydraulic test" is used to verify the integrity of the striated sphincter: when the irrigation fluid is stopped the sphincter will contract and when the fluid is restarted the sphincter will open.

2.5.10 Urethro-Vesical Catheter Indwelling

An 18–22F urethro-vesical catheter is inserted at the end of the procedure. How long the Foley catheter has to stay in place is still a matter of debate, but most authors recommend 1–3 days (Albers et al., 1996; Hossain et al., 2004; Leyh and Paul, 2005). This subject will be further discussed in the section dedicated to the posturethrotomy management of patients with urethral strictures.

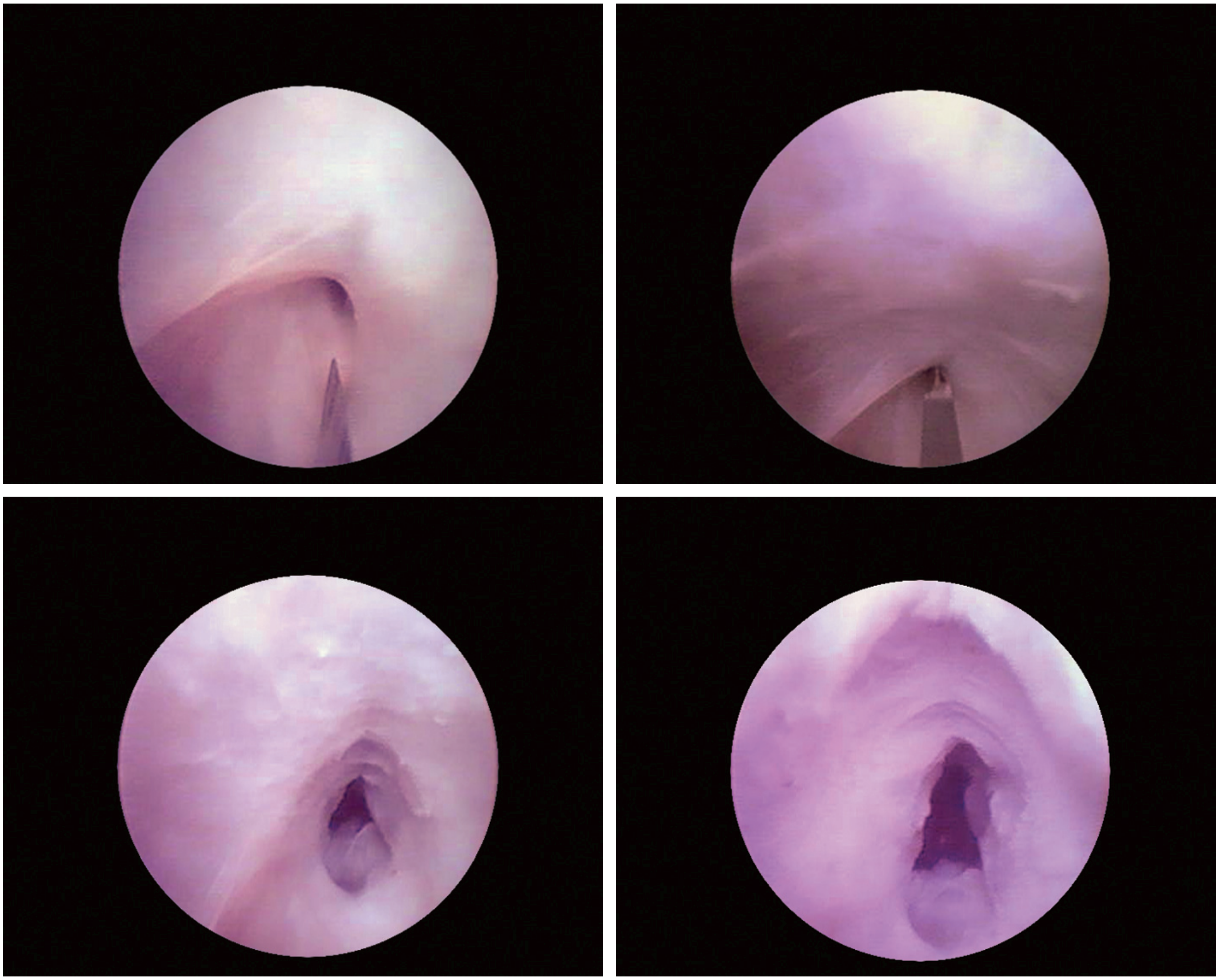

FIGURE 2.30 **Progressive cold knife incision, with visualization of the correct direction along the urethral lumen axis.**

The catheterization is done directly (if it is possible) or using a metallic half-sheath with the help of a straight mandrin. The half-sheath is attached to the inferior compass of the working part of the endoscope and placed in the proper position by reinserting the whole ensemble up into the bladder (Fig. 2.54).

One end of the half-sheath will remain at the level of the urethral meatus, while the other has to overpass the posterior lip of the bladder neck (Fig. 2.55).

Insertion of the urethro-vesical catheter, mounted on the straight mandrin, must be done with a full bladder, to avoid wall injuries (Fig. 2.56).

The half-sheath and the straight mandrin are pulled out (in this order) once the balloon of the catheter overpasses the bladder neck (Fig. 2.57).

In case of optical urethrotomies done using bipolar approach the urethro-vesical catheter is placed under direct visual control, using the flexible cystoscope with its distal tip kept inside the bladder (Fig. 2.58).

2.6 ENDOSCOPIC URETHROPLASTY

Endoscopic urethroplasty is a modified optical urethrotomy in which a graft made from different materials is inserted after incision at the site of the stricture to prevent relapse. After cold knife incision, different types of grafts may be applied after they are fitted on the distal tip of a Foley catheter: split skin graft (Pettersson et al., 1978), patch

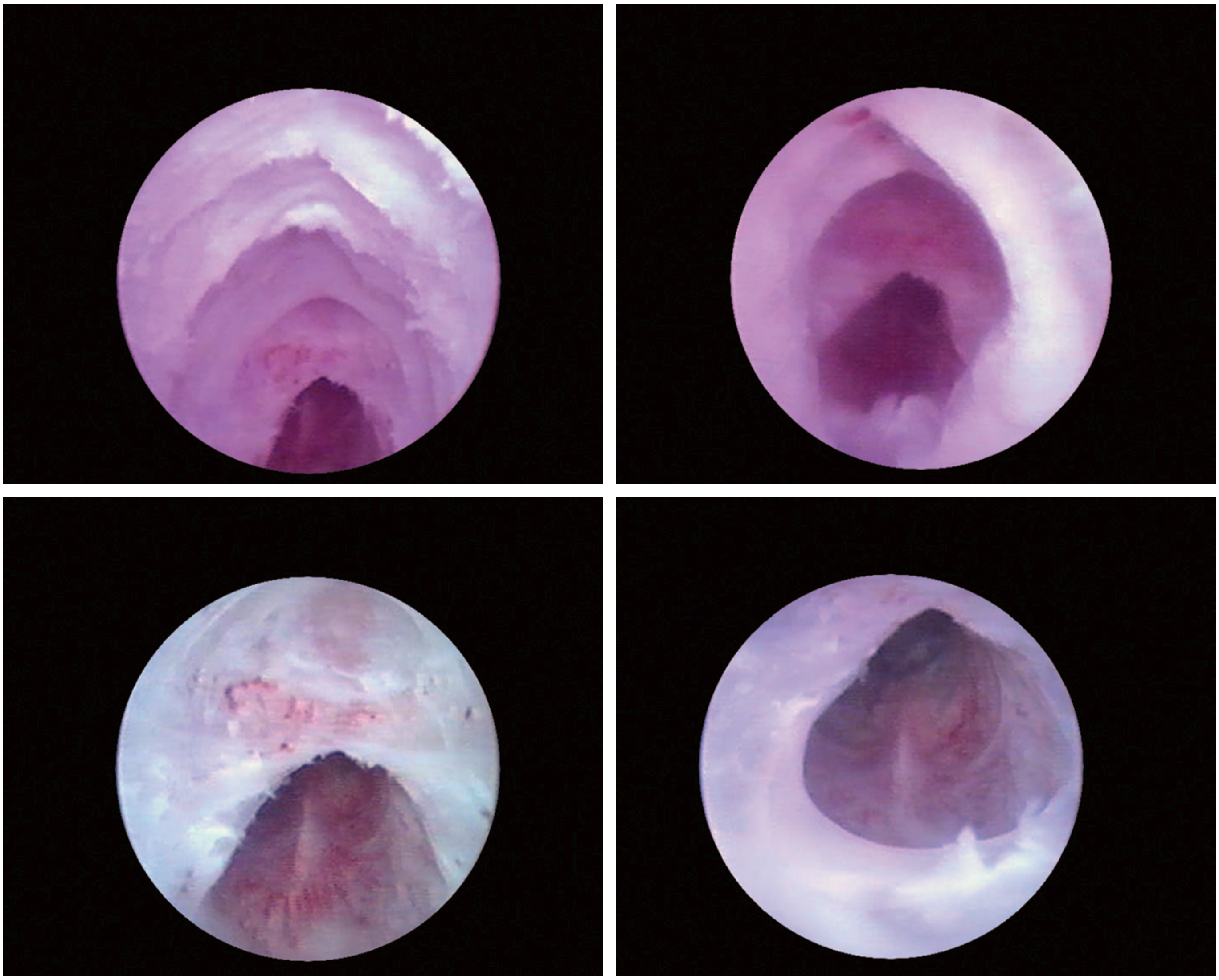

FIGURE 2.31 Cold knife incision with cutting of the spongiofibrosis in its entire depth, until healthy underlying tissue is exposed.

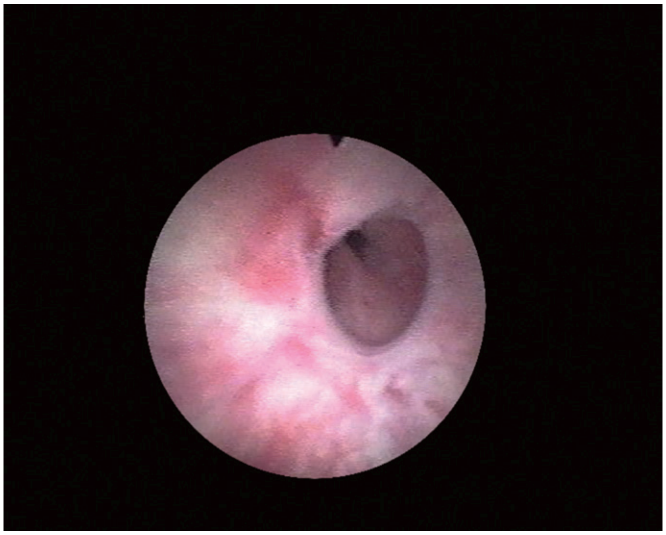

FIGURE 2.32 Stricture of the proximal bulbar urethra, close to the striated sphincter.

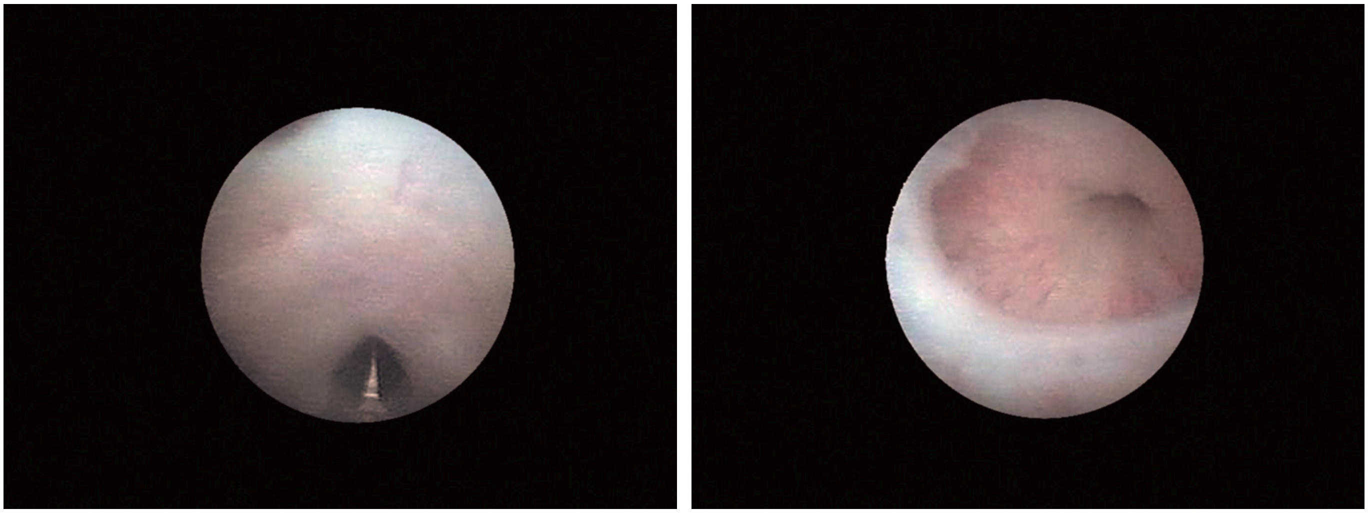

FIGURE 2.33 **Cold knife incision of a stricture of the proximal bulbar urethra, protecting the striated sphincter.**

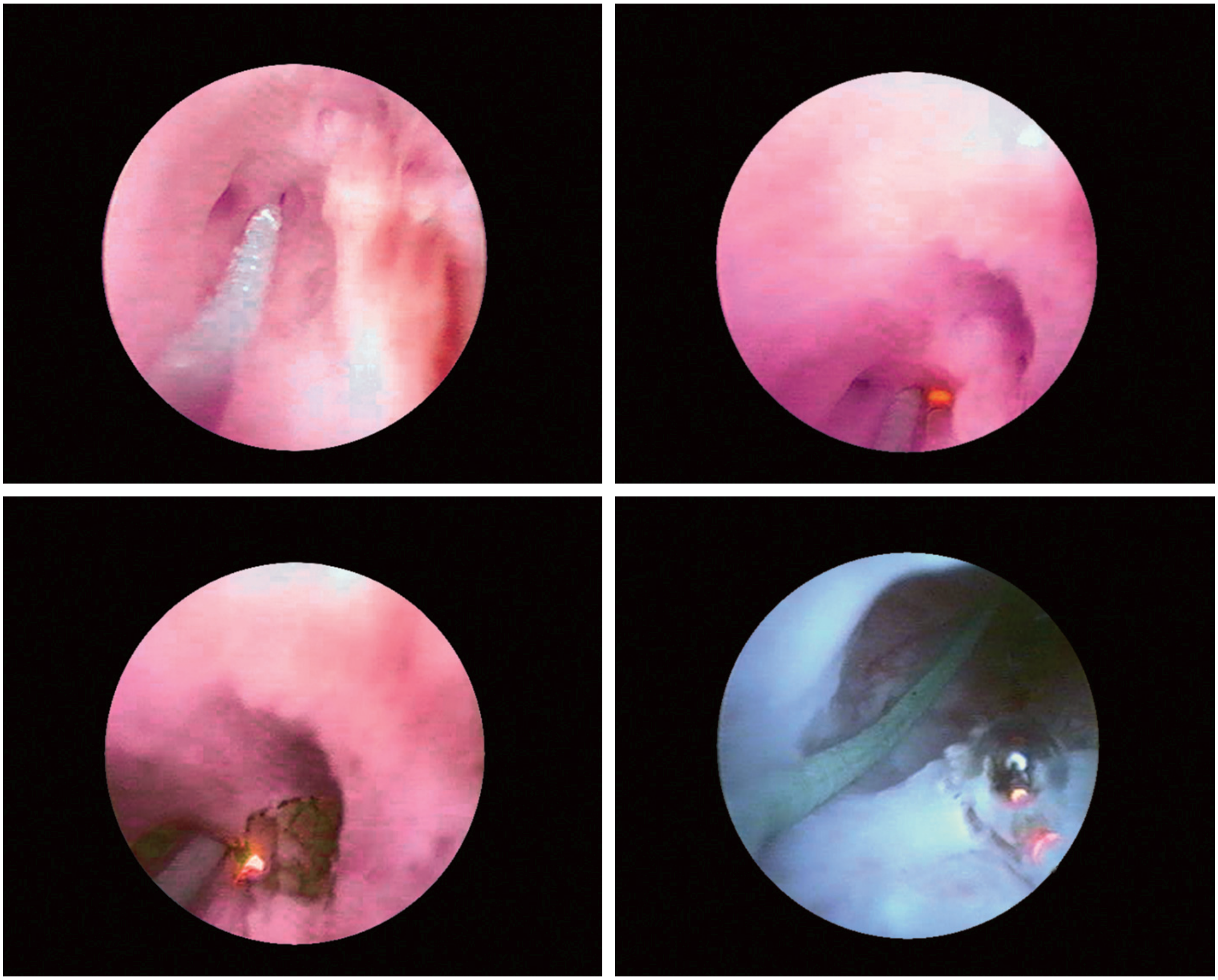

FIGURE 2.34 **Laser urethrotomy guided along the safety wire inserted through the stenosis.**

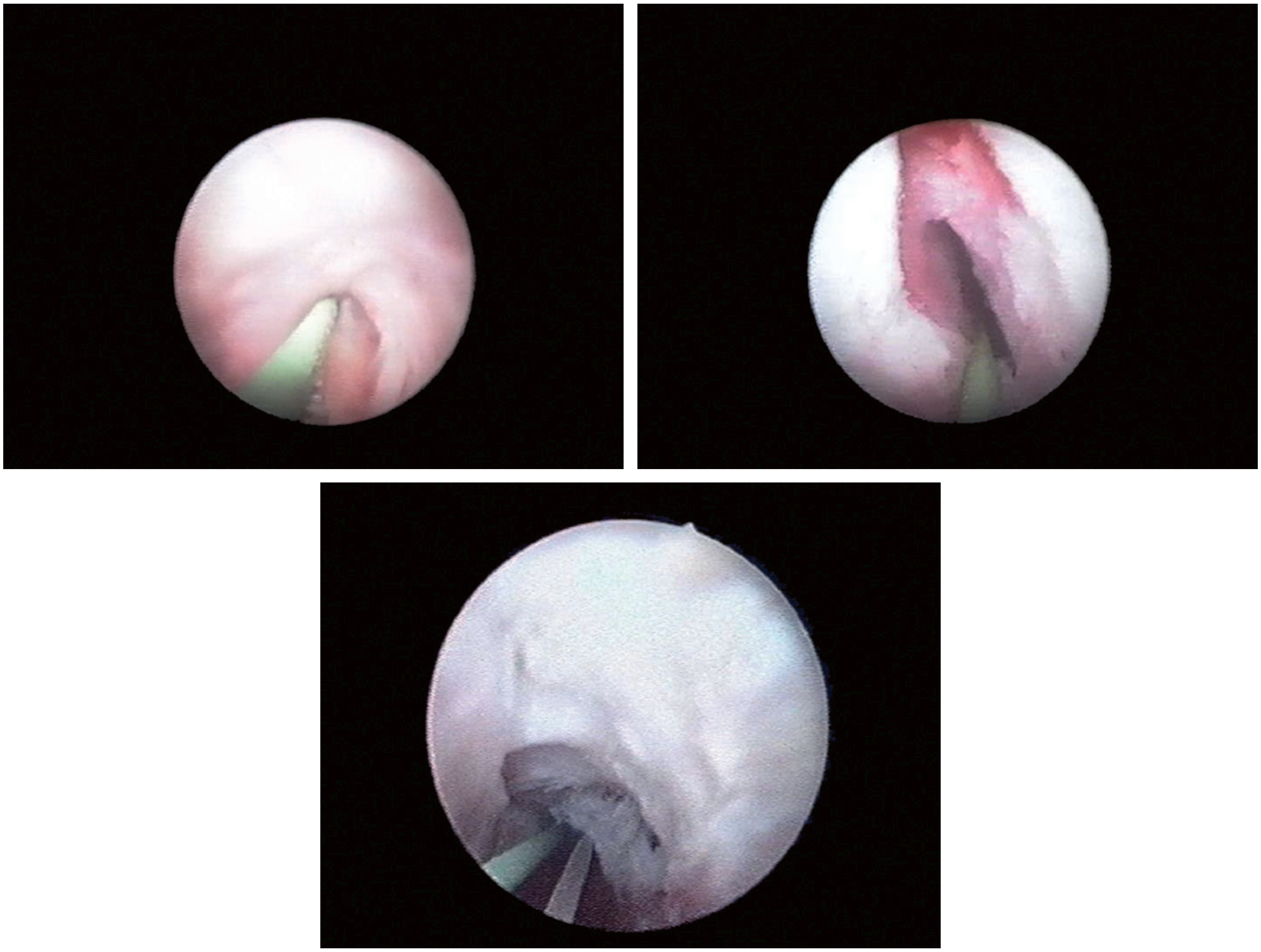

FIGURE 2.35 **Cold knife incision guided along the safety wire inserted through the stenosis.**

made from the small intestinal submucosa (Surgisis® Biodesign single-layer Cook Medical) (Farahat et al., 2009), foreskin (Zhang et al., 1989), etc. Skin grafts are positioned with the epithelial layer toward the Foley catheter. The tissue patch has to exceed the incision site by 1 cm upward and 1 cm downward. The excessive tissue is spontaneously eliminated through necrosis.

The incision must involve the area of spongiofibrosis in its entire depth but without damaging the corpus cavernosum. Cases of endoscopic urethroplasty after incision with resection of the fibrous tissue (Zhang et al., 1989) or after plasma electrovaporization of this tissue (Dong et al., 2009) have been reported. A transurethral metallic wire is left in place following urethrotomy. A 12F Foley catheter, with the graft attached to its distal tip (around the balloon) with 4/0 absorbable threads advances along the metallic wire to the site of the incision. It is possible to check the position using a 15F urethrocystoscope inserted beside the catheter. After checking the position, the balloon is inflated until the graft comes in close contact with the incision bed, after which the urethrocystoscope is pulled out and the catheter is attached to the glans with 2/0 nonabsorbable threads.

For fixing the catheter and the graft, Naude, and then Le Roux, use two threads brought together at the perineum. The upper thread is placed percutaneous through the perineum, with the lower one transurethral, using a special needle inserted into the working channel of the cystoscope. These threads prevent the longitudinal displacement of the catheter and implicitly prevent displacement of the graft from the site of the incision (Naude, 1998; Le Roux, 2005). At the end of the procedure a suprapubic cystostomy is performed to drain the urine from the bladder (Farahat et al., 2009).

An alternative technique, for strictures of the proximal urethra, consists of measuring the distance between the bladder neck and the stenosis and applying the patch to the Foley catheter at an equal distance from the balloon.

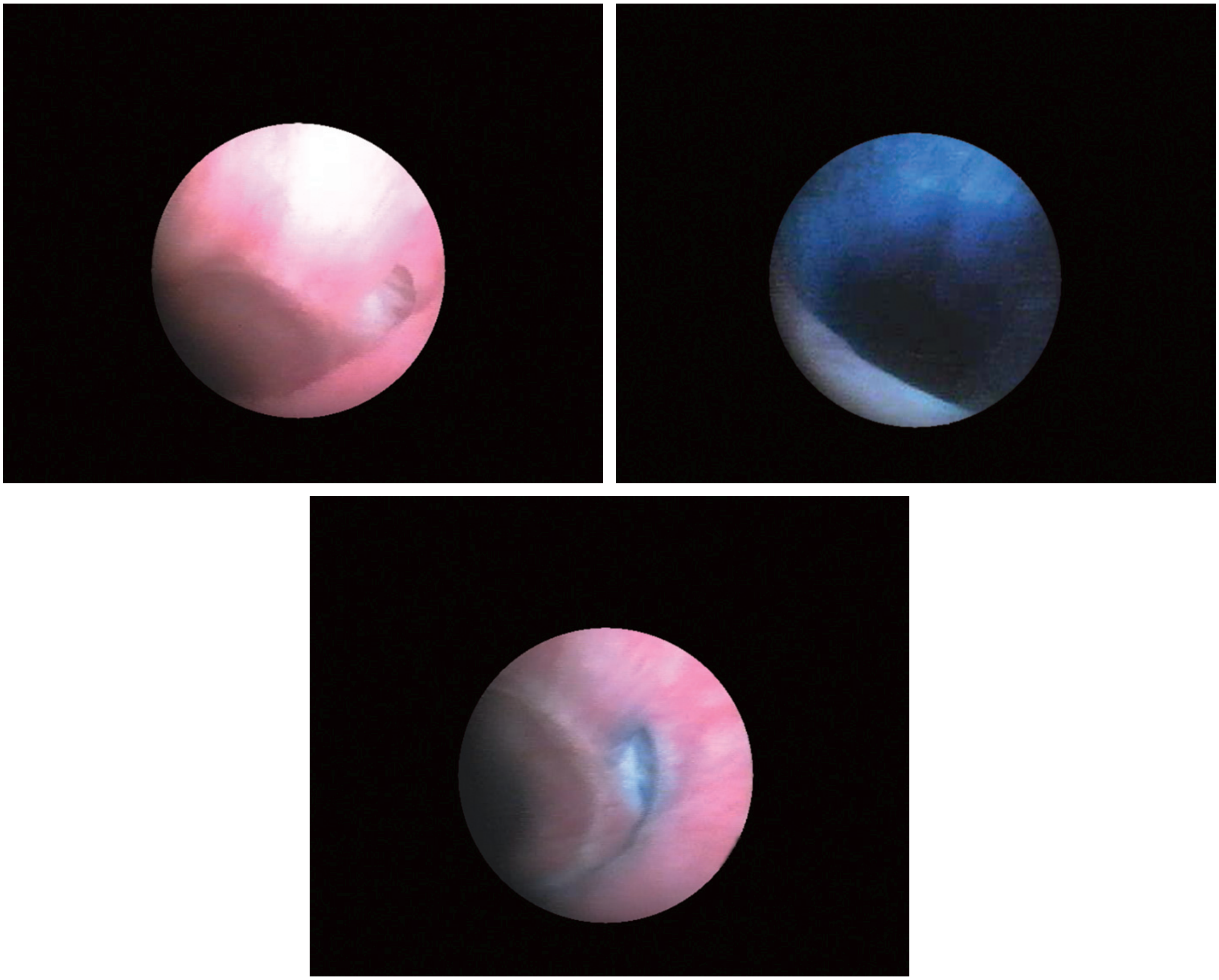

FIGURE 2.36 Instillation of methylene blue into the bladder allows for identification of the stenosed urethral lumen, lateral to a large, epithelialized, false passage.

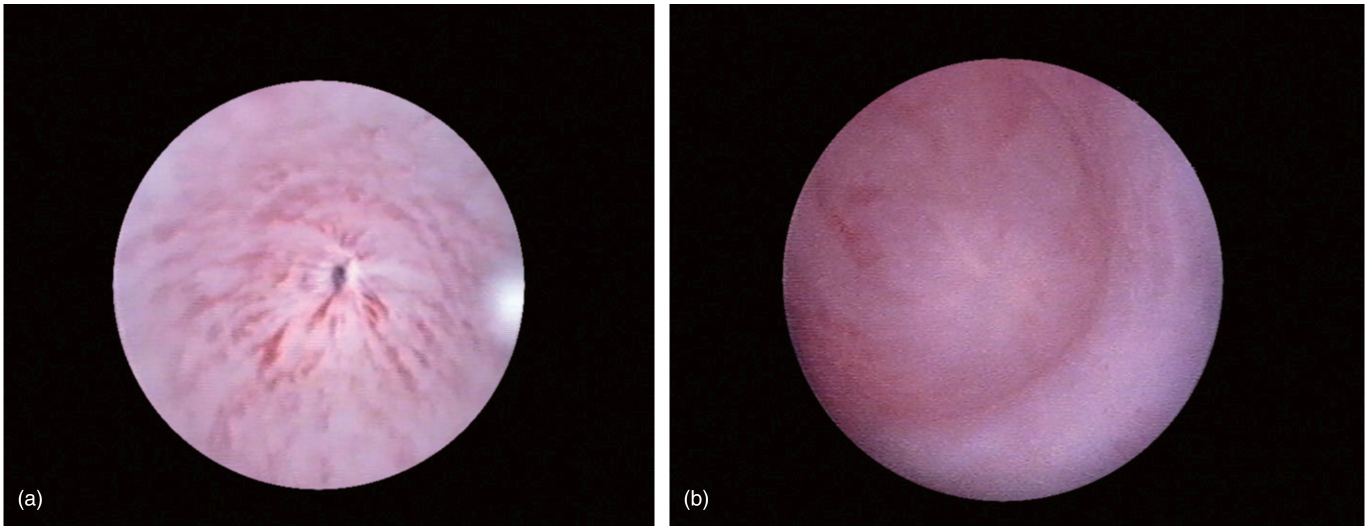

FIGURE 2.37 Punctiform stricture (a) and complete obstruction of the urethral lumen (b).

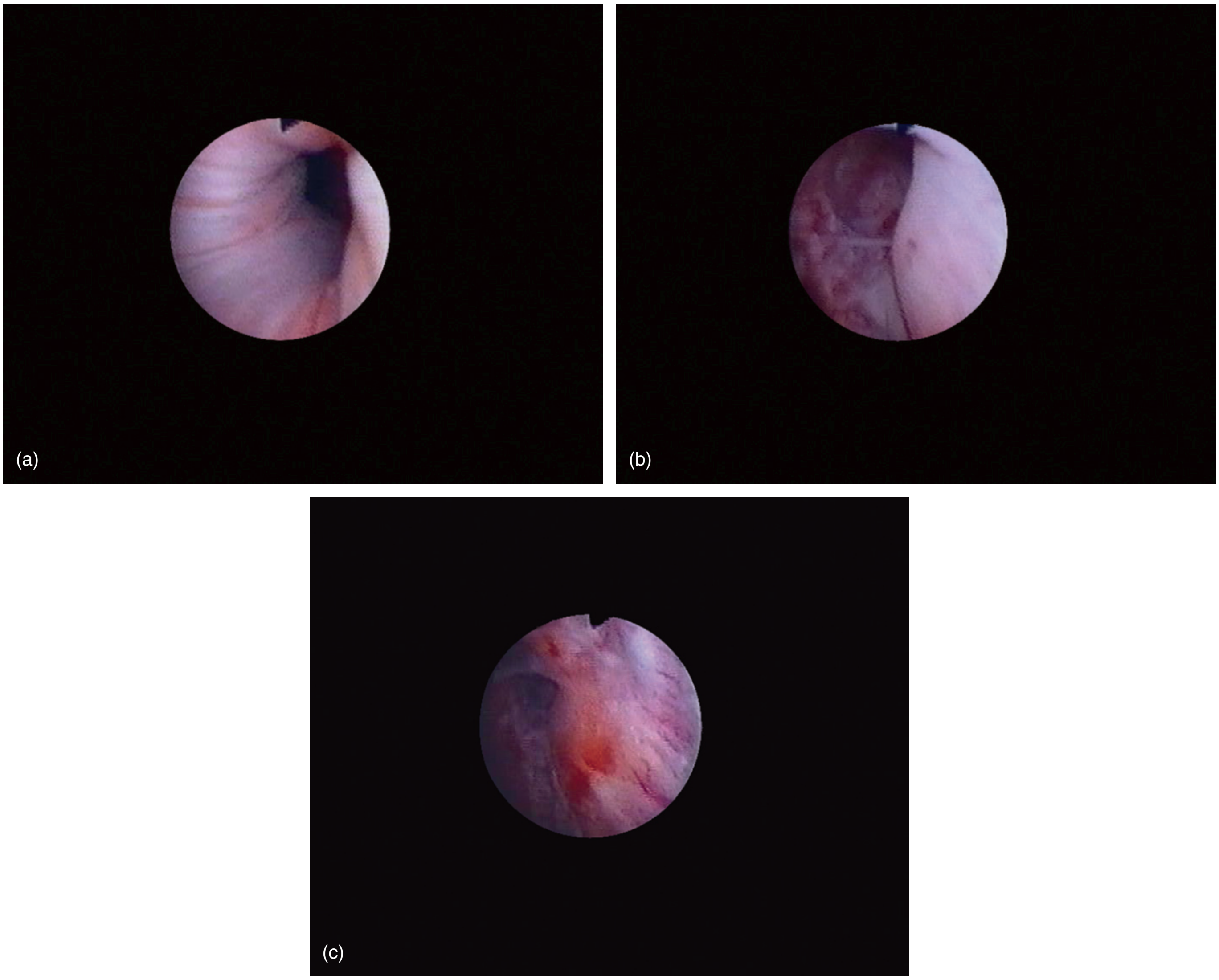

FIGURE 2.38 **Anterograde, transvesical insertion of a flexible cystoscope through the bladder neck (a) and the prostatic urethra (b), close to the stricture (c).**

After the catheter is placed, the graft is attached to the incision site using pressure dressings, which is left in place for 1 week. The urethro-vesical catheter is extracted after 8–18 days and the suprapubic cystostomy after 4 weeks (Calomfirescu and Voinescu, 2001).

Gaur (1983) used a special catheter with two balloons, one inside the bladder and another one to attach the graft to the incision site. The urethro-vesical catheter is left in place for 2 weeks (Farahat et al., 2009).

Oosterlinck described a hybrid technique between endoscopic urethroplasty and urethral stenting. In his study, a foreskin tissue patch was attached to a resorbable polyglycolic acid stent, which was fixed to the bulbar stricture with percutaneous threads after incision. In this study, biological prostheses with reabsorbtion in 3 weeks were used (Oosterlinck and Talja, 2000).

2.7 COMPLICATIONS

The incidence of events and complications in urethrotomies varies between 11% and 18%. The failure rate for technically performing urethrotomy (including failure due to complications) can reach 13% (Steenkamp et al., 1997; Stormont et al., 1993).

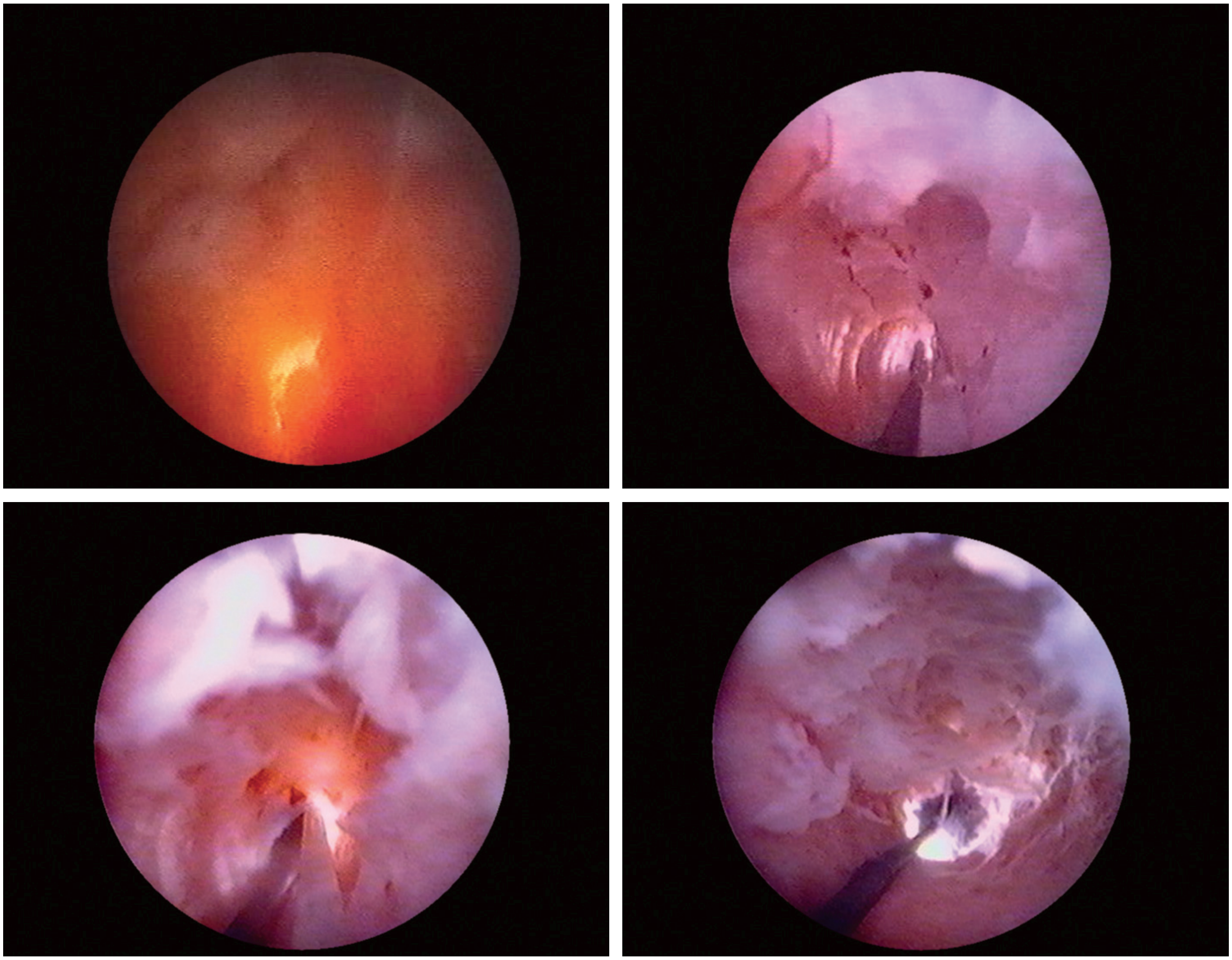

FIGURE 2.39 Cold knife urethrotomy guided toward the light of the flexible cystoscope, which was inserted anterogradely into the urethra.

2.7.1 Intraoperative Incidents

2.7.1.1 Injuries of the Striated Sphincter

The striated sphincter may be injured during urethrotomies done for strictures of the proximal bulbar urethra, resulting in postoperative urinary incontinence.

2.7.1.2 Deterioration of the Devices

The urethrotome, the flexible cystoscope used for bipolar approach, or the laser fibers may be deteriorated during urethrotomies, sometimes requiring active measures to remove the fragments (Fig. 2.59) or even interruption of the procedure.

2.7.1.3 Minor Bleeding

Usually there is no need for active measures or termination of the procedure. However, visibility may be reduced and the procedure may become more difficult to perform (Fig. 2.60).

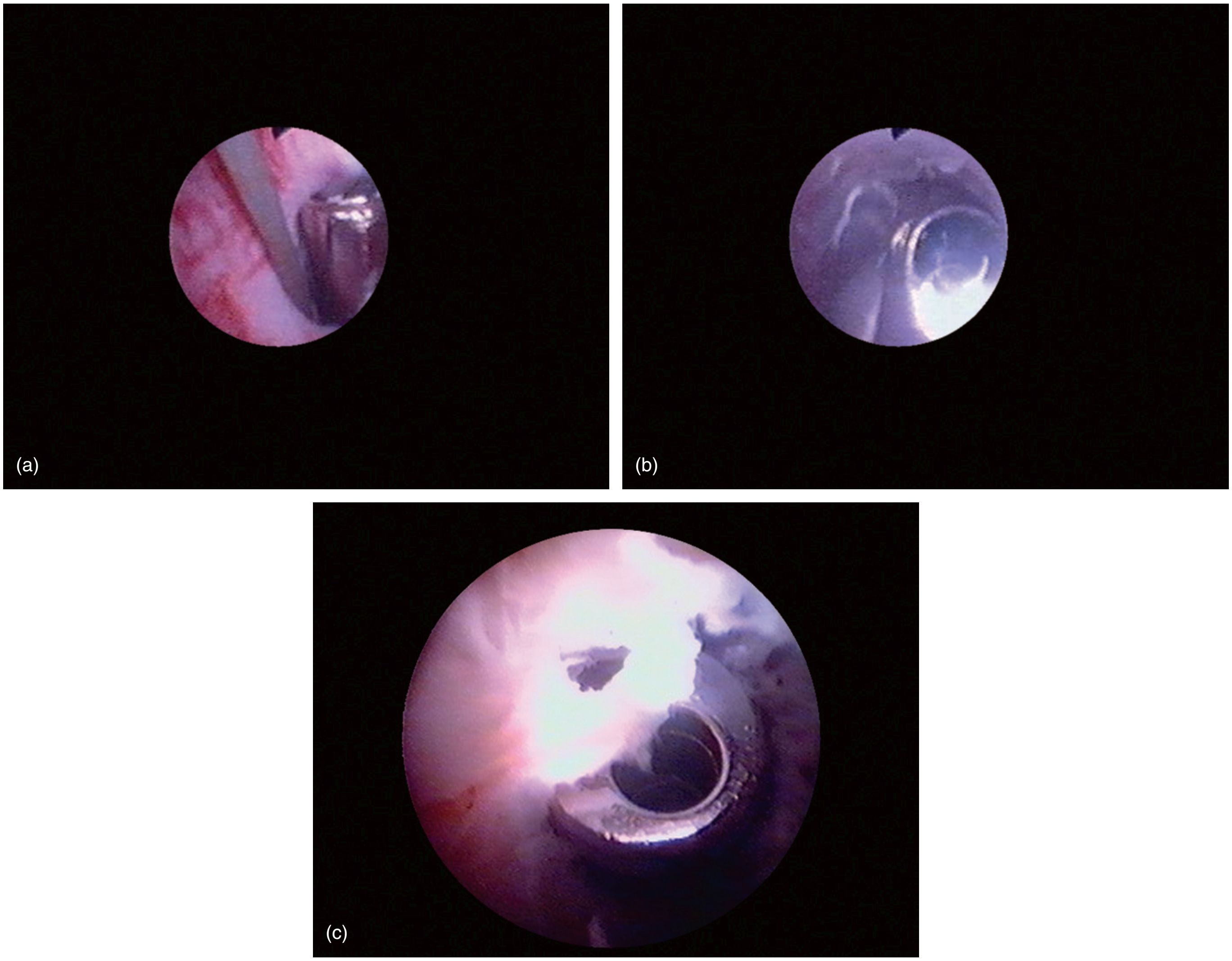

FIGURE 2.40 Urethrotome (a, b) and flexible cystoscope (c) in contact after incision of the stricture.

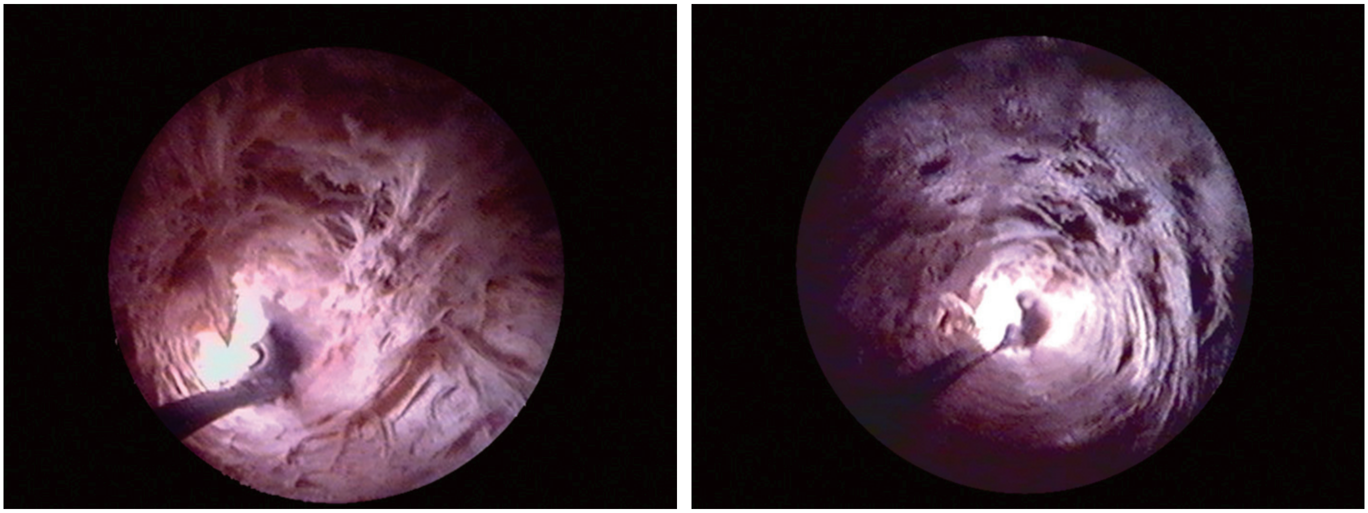

FIGURE 2.41 Large urethral lumen obtained after a urethrotomy done with bipolar approach.

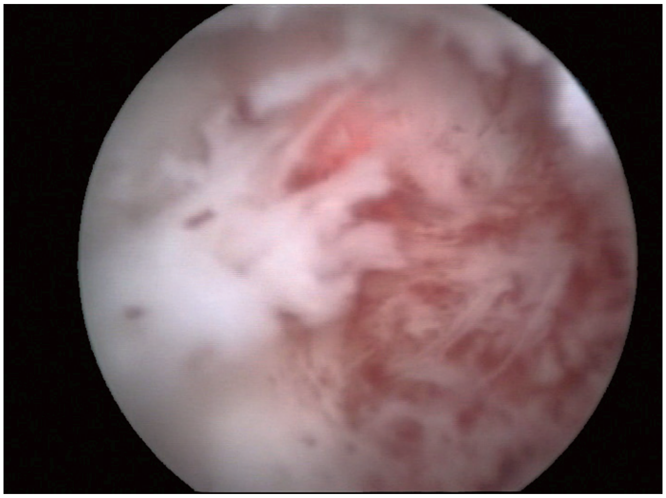

FIGURE 2.42 **Iatrogenic false urethral passage underlying a punctiform stricture, with a urethral lumen that cannot be identified.**

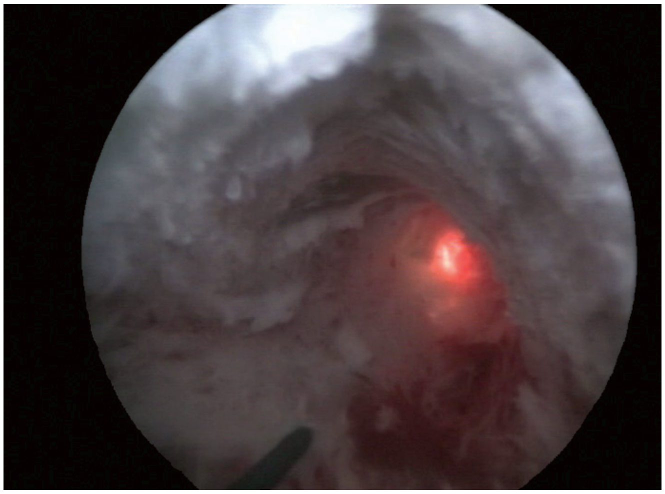

FIGURE 2.43 **Anterograde insertion of a hydrophilic wire through the flexible cystoscope.**

2.7.2 Intraoperative Complications

2.7.2.1 *Major Bleeding*

Intraoperative major bleeding may occur because of injuries of the blood vessels (urethral arteries or their branches) or of the corpus cavernosum during incision. Laser or electrical urethrotomies have a lower bleeding risk compared to cold knife procedures. Incisions done with the Otis urethrotome have a higher bleeding risk compared to optical urethrotomy, due to the lack of visual control. Bleeding is usually controlled by inserting a 22–24F catheter, sometimes associated with a compressive dressing on the penis (Leyh and Paul, 2005).

2.7.2.2 *Edema of the Penis and Scrotum*

Edema of the penis and scrotum may develop during the procedures, when the incisions are done, due to extravasation of the irrigating fluid into the subcutaneous tissue of the external genitalia. In case of important edema, the procedure has to be stopped. This complication requires antibiotic prophylaxis and the edema usually reabsorbs in 1–2 days. Punctual punches in the skin may be done to assist the drainage of the fluid.

2.7.2.3 *False Passages and Urethral Perforation*

These may occur when the real direction of the lumen is not followed during incision. For very tight strictures, the direction of the urethral lumen has to be confirmed with one of the methods described in the section dedicated to the surgical techniques (wire placing, anterograde instillation of methylene blue, etc.). For small false passages, a urethro-vesical catheter is enough for treatment, while for the bigger ones, the septum between the false passage and the urethral lumen has to be cut (Fig. 2.61).

2.7.2.4 *Bladder Perforation*

Bladder perforation may occur when the urethro-vesical catheter is placed using the half-sheath with the help of a straight mandrin, especially when the bladder is not completely distended. Usually, the perforation is into the retroperitoneal space, and a longer-term urethro-vesical drainage (2–3 weeks) is sufficient to solve this complication.

2.7.2.5 *Perineal Hematoma*

Perineal hematoma may occur in case of injury of the vascular structures, especially during urethrotomies for strictures of the bulbar urethra. A higher incidence was described for the Guillemin technique, in which incision was associated with transurethral resection of the spongiofibrosis process (Giannakopoulos et al., 1997).

2.7.3 Postoperative Complications

2.7.3.1 *Infections*

Infections (urethritis, periurethritis, perineal suppurative infections, etc.) are early postoperative complications. Bacteremia may also follow after a urethrotomy. These complications can be very serious, especially in patients

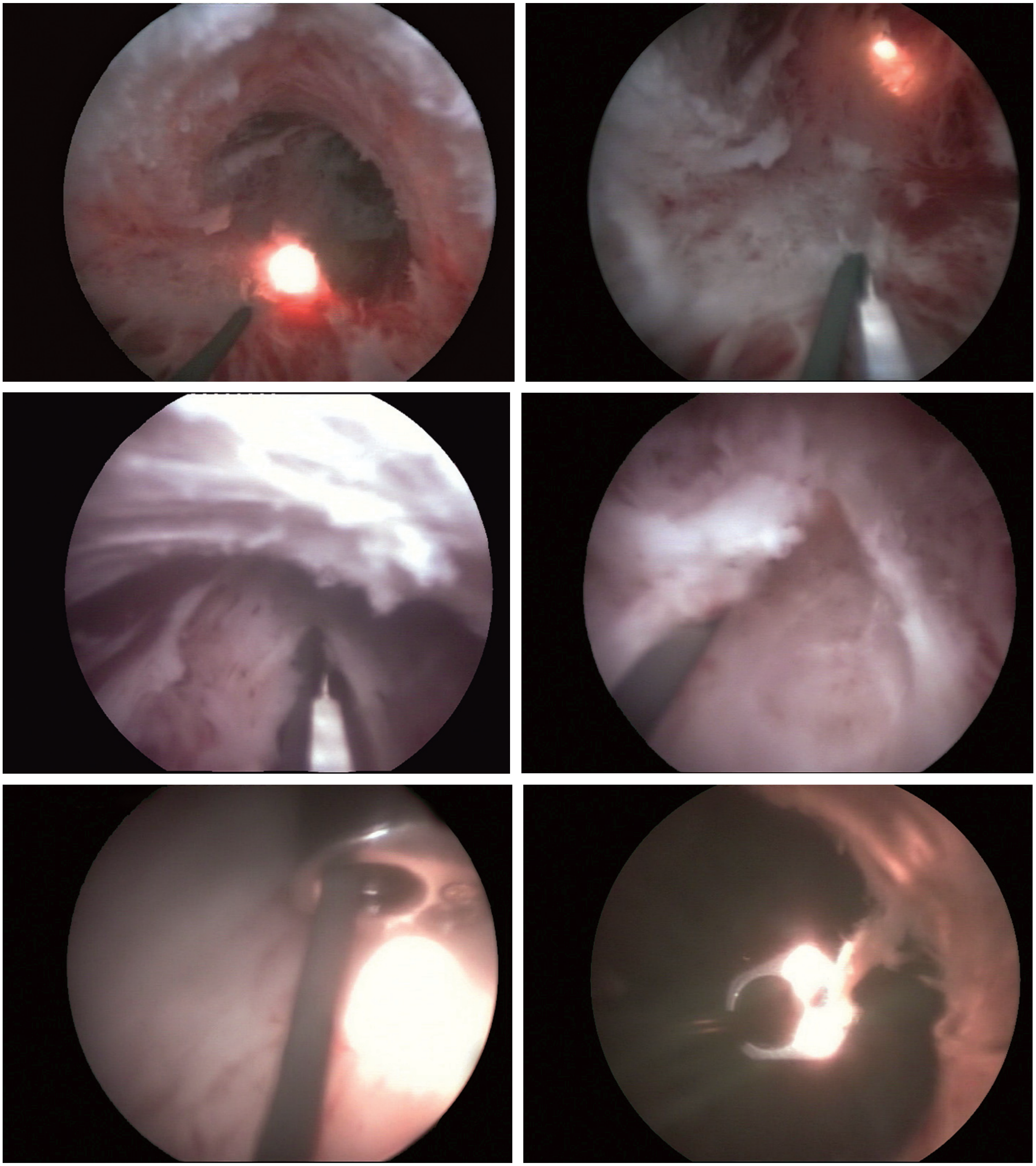

FIGURE 2.44 **Optical internal urethrotomy with cold knife, using the two landmarks: the wire inserted anterogradely and the light of the flexible cystoscope.**

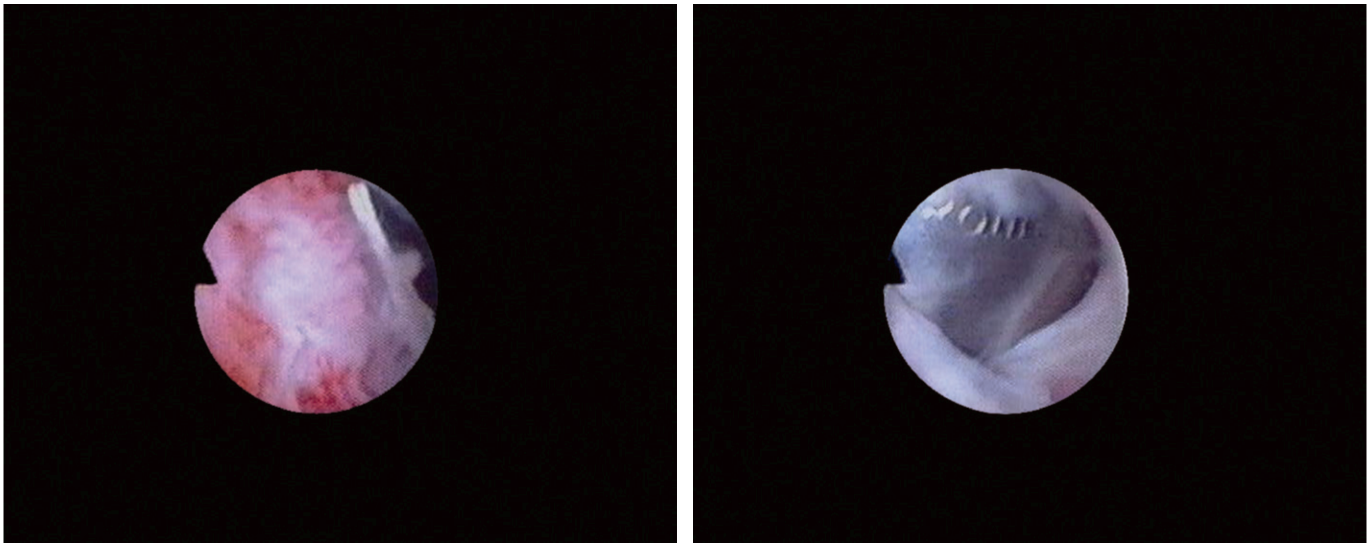

FIGURE 2.45 **Incision of the distal penile urethra stenosis under visual control using a flexible cystoscope passed anterogradely into the urethra.**

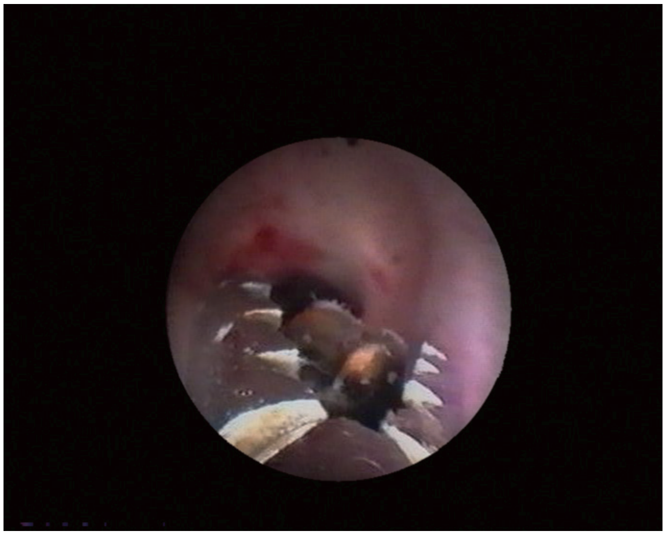

FIGURE 2.46 **A urethral stone above a stricture is pulled out with a forceps.**

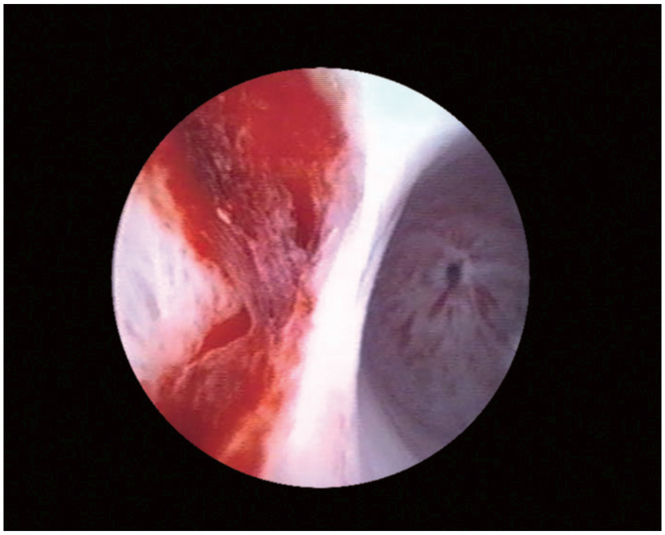

FIGURE 2.47 **Iatrogenic false passage beneath a urethral stricture, after an attempt of urethro-vesical catheterization.**

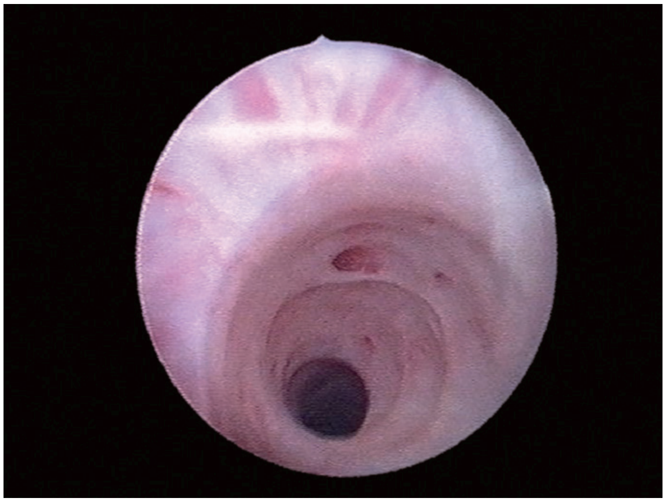

FIGURE 2.48 **A small false passage beneath a urethral stricture.**

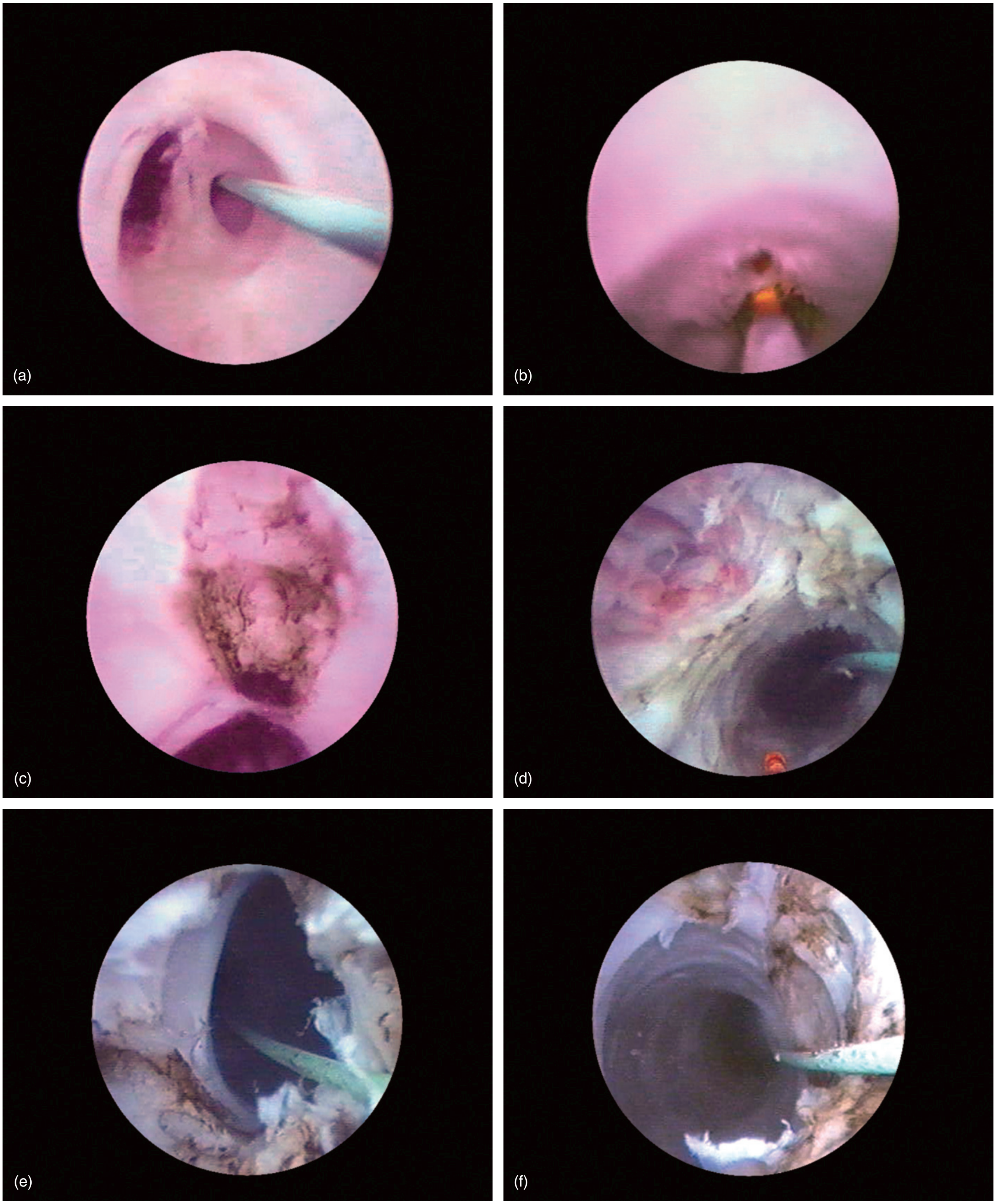

FIGURE 2.49 **(a) Urethral stricture associated with a false passage. (b–d) Laser incision with destruction of the septum between them, (e, f) followed by laser urethrotomy.**

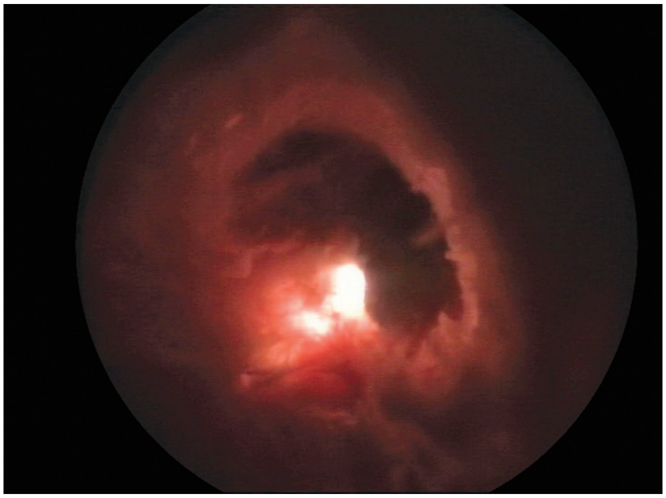

FIGURE 2.50 **Iatrogenic false passage, with the light of the flexible cystoscope inserted anterogradely, visible through tissue transparency.**

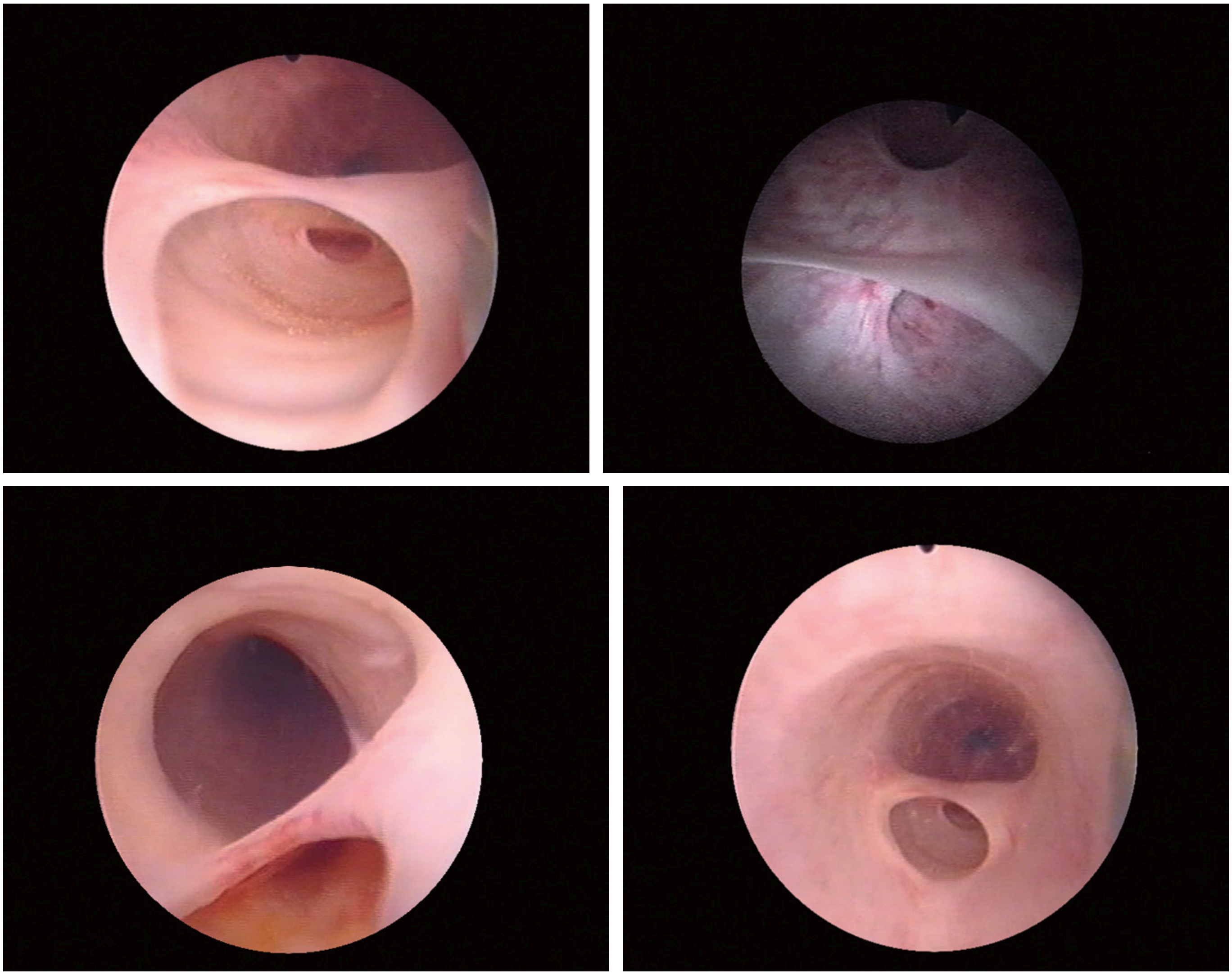

FIGURE 2.51 **Old, epithelialized urethral false passages.**

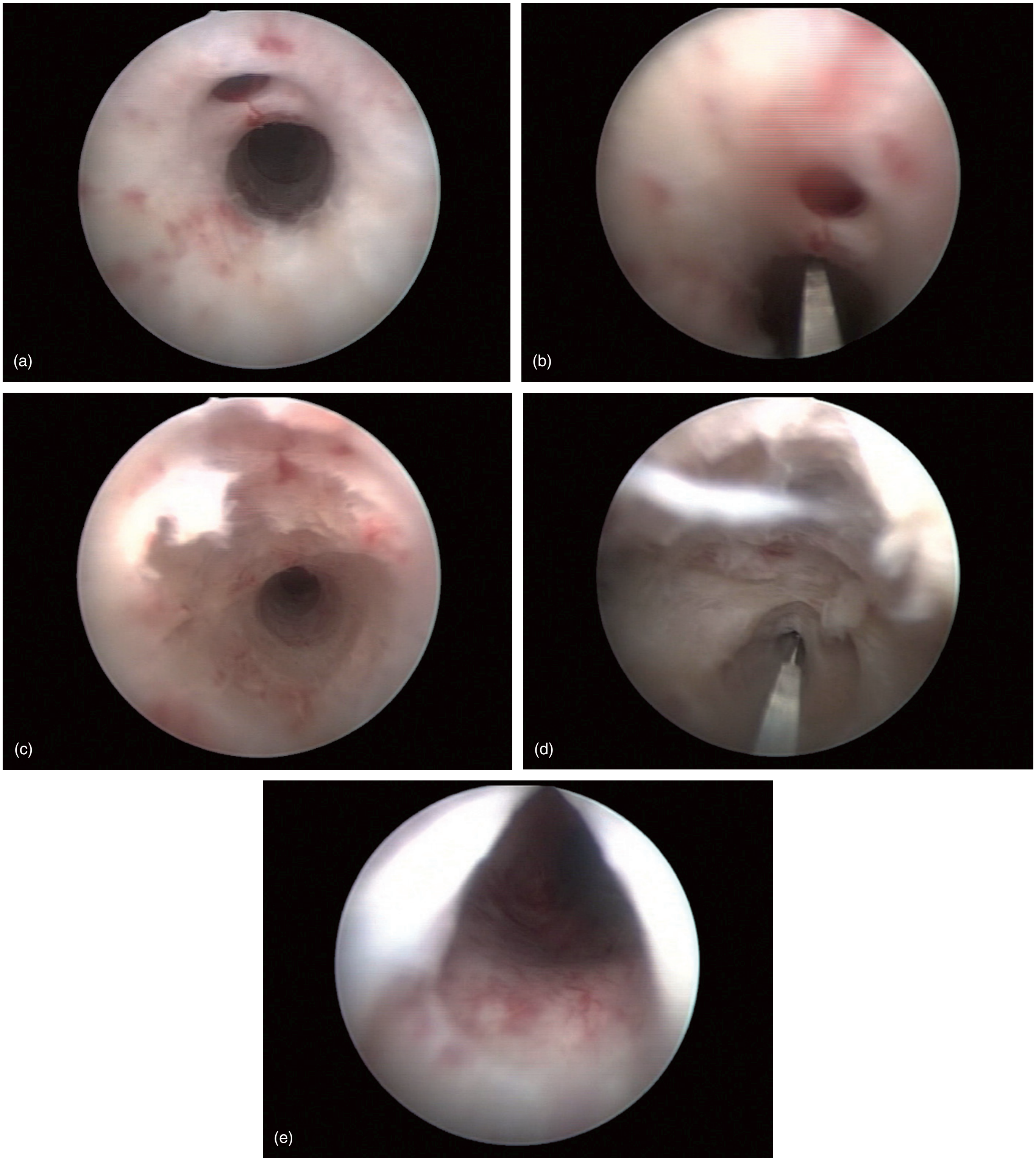

FIGURE 2.52 Epithelialized urethral false passage above a urethral stricture (a), destroyed by cold knife incision (b, c), followed by urethrotomy for the stenosis (d, e).

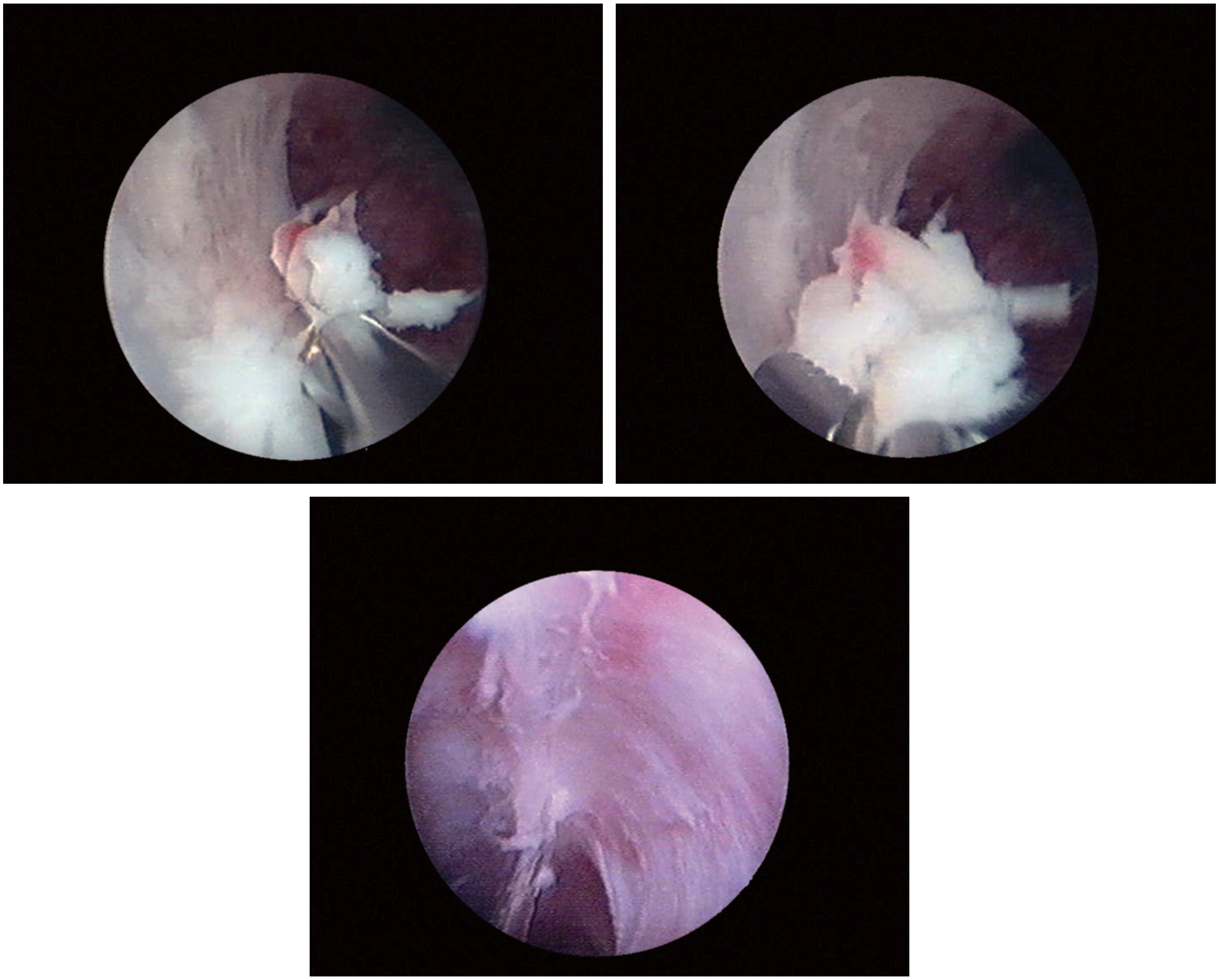

FIGURE 2.53 “Cold-cup” biopsies form the site of the incision.

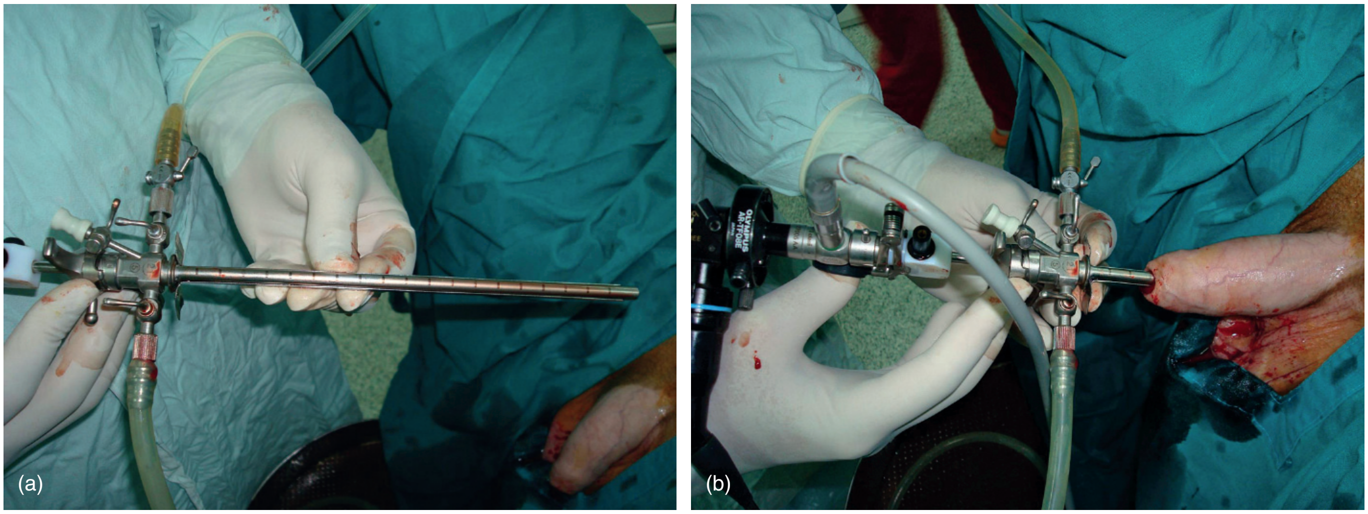

FIGURE 2.54 (a) Attaching the metallic half-sheath to the urethrotome and (b) insertion of the ensemble into the urethra.

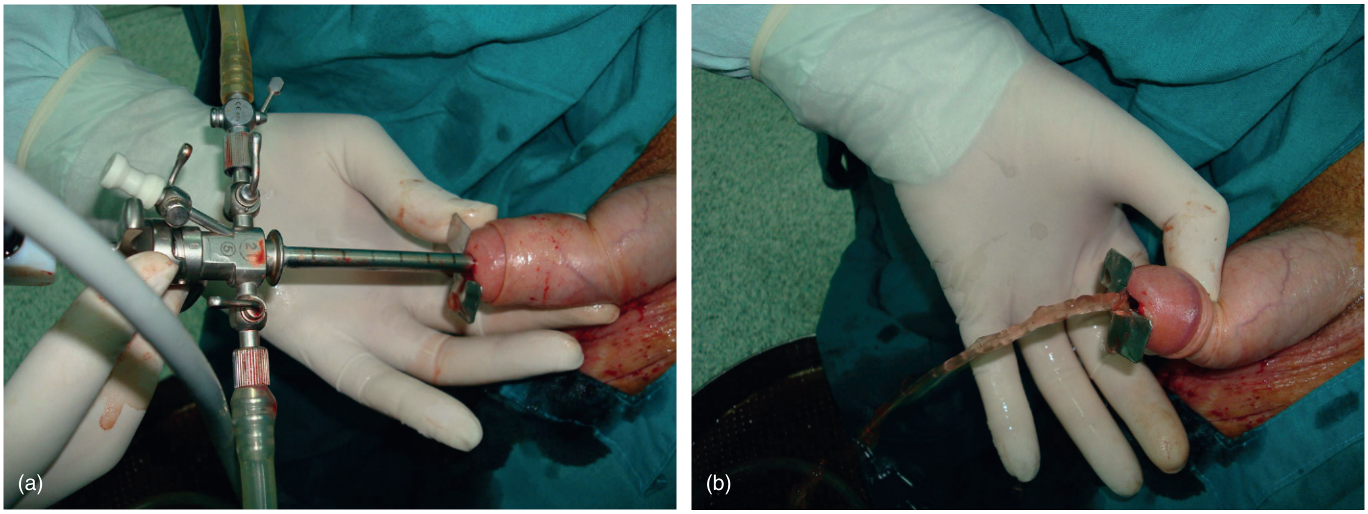

FIGURE 2.55 **Pulling out the urethrotome (a) with the half-sheath left in place in the urethra (b).**

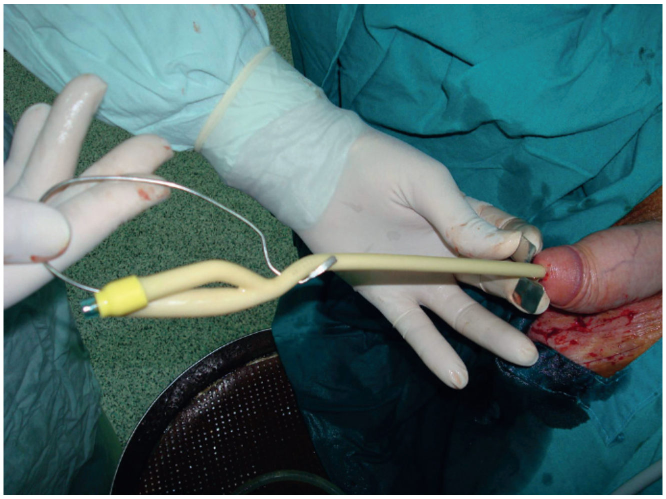

FIGURE 2.56 **Placing the urethro-vesical catheter, mounted on the straight mandrin, on the half-sheath.**

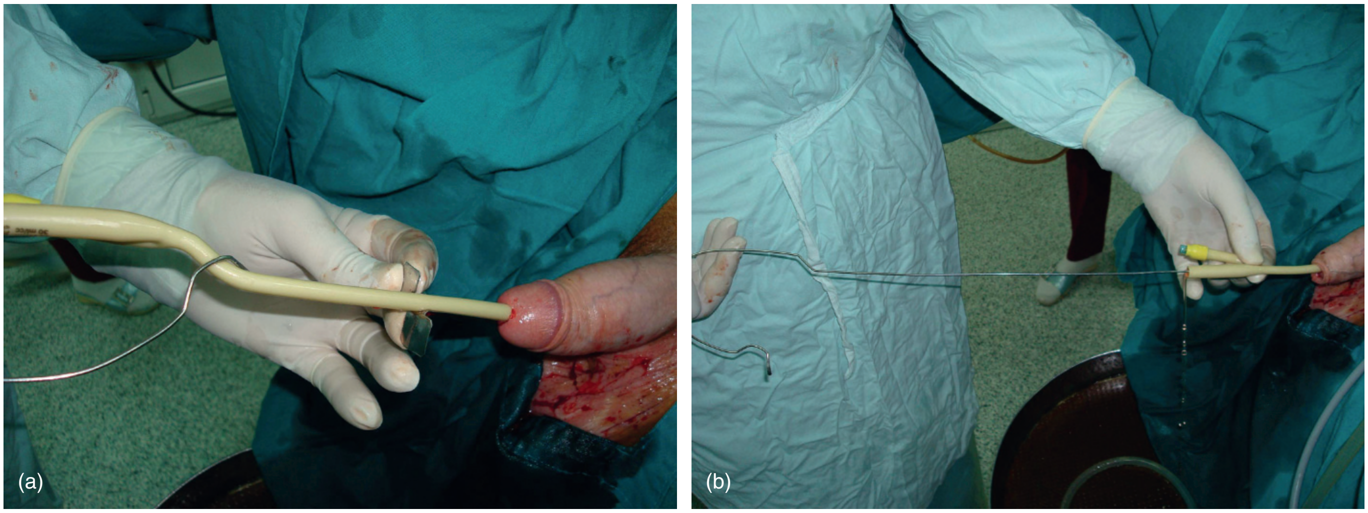

FIGURE 2.57 **The half-sheath (a) and the straight mandrin are pulled out (b), leaving in place the Foley catheter.**

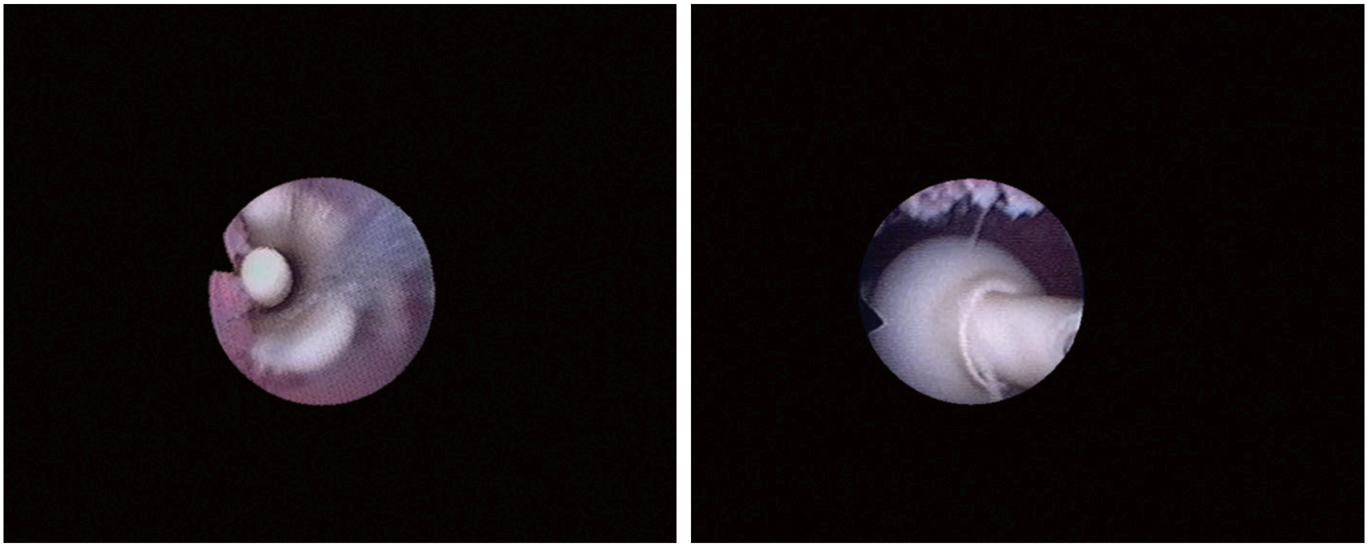

FIGURE 2.58 Urethro-vesical catheterization done under control with flexible cystoscope, after a urethrotomy by bipolar approach.

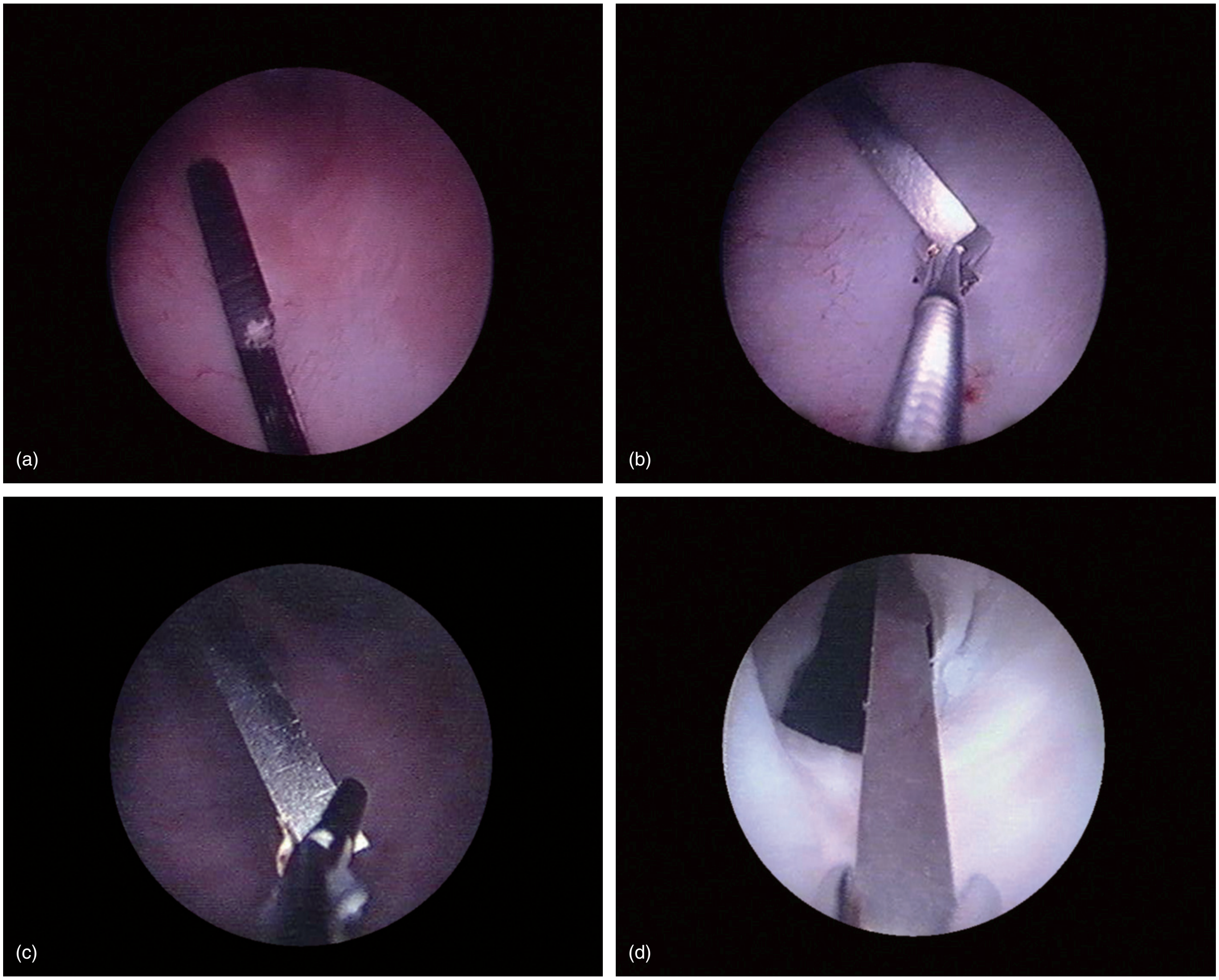

FIGURE 2.59 Knife of the urethrotome broken inside the bladder (a), pulled out with a forceps (b–d).

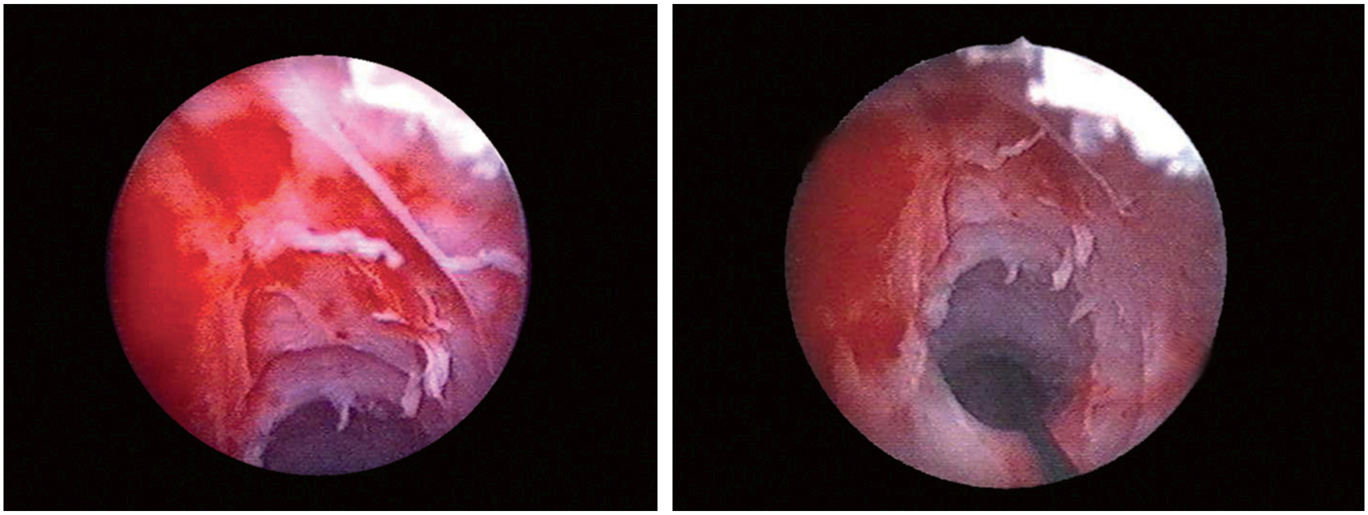

FIGURE 2.60 Minor bleeding during cold knife optical internal urethrotomy.

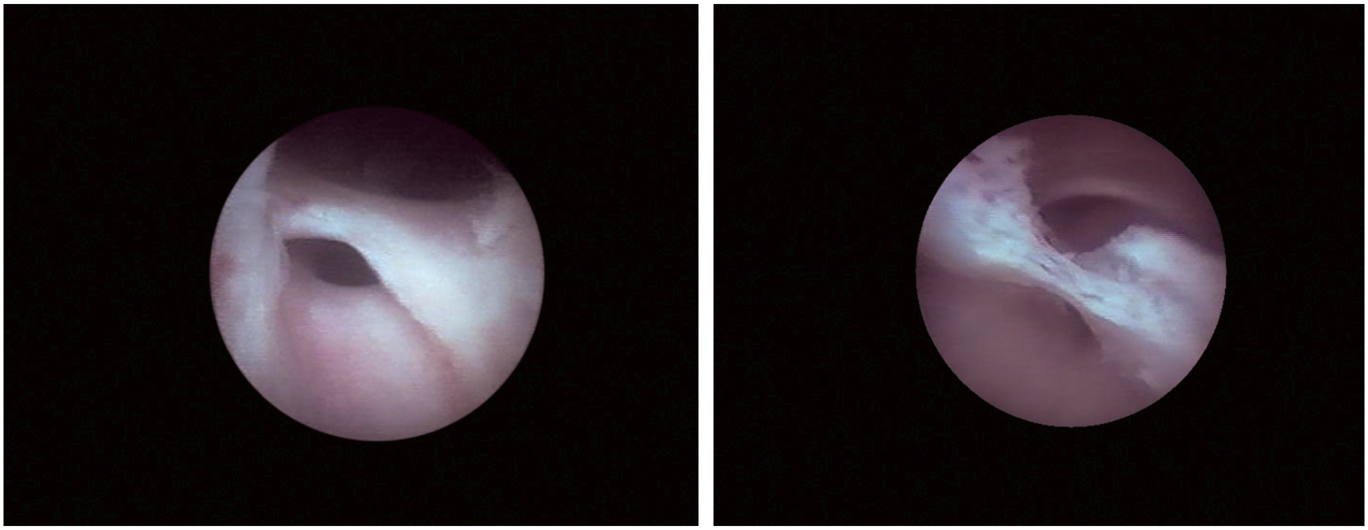

FIGURE 2.61 Urethral false passage, which requires endoscopic sectioning of the mucosal septum.

with multiple procedures in the past because they may acquire nosocomial infections with multidrug resistance. If prophylaxis and treatment with proper antibiotics are not initiated, evolution may be complicated by periurethral abscesses, fistulas and even gas gangrene, suppurative infection of the subperitoneal fat tissue, and/or septicemia.

2.7.3.2 *Urethrorrhagia*

Postoperative urethrorrhagia is frequently the consequence of a postoperative erection. A urethro-vesical catheter is in most cases enough to solve this complication.

2.7.3.3 *Urinary Incontinence*

Postoperative urinary incontinence is due to the injury of the striated sphincter, especially during the incision of proximal bulbar urethra strictures. Solving this complication can be a difficult task, the therapeutic options ranging from periurethral injection of different substances to artificial sphincters.

2.7.3.4 *Restenosis*

Relapse of the urethral stricture is the most frequent late postoperative complication (Fig. 2.62). Relapse may be associated with an increase in spongiofibrosis and often requires to be treated by open surgery.

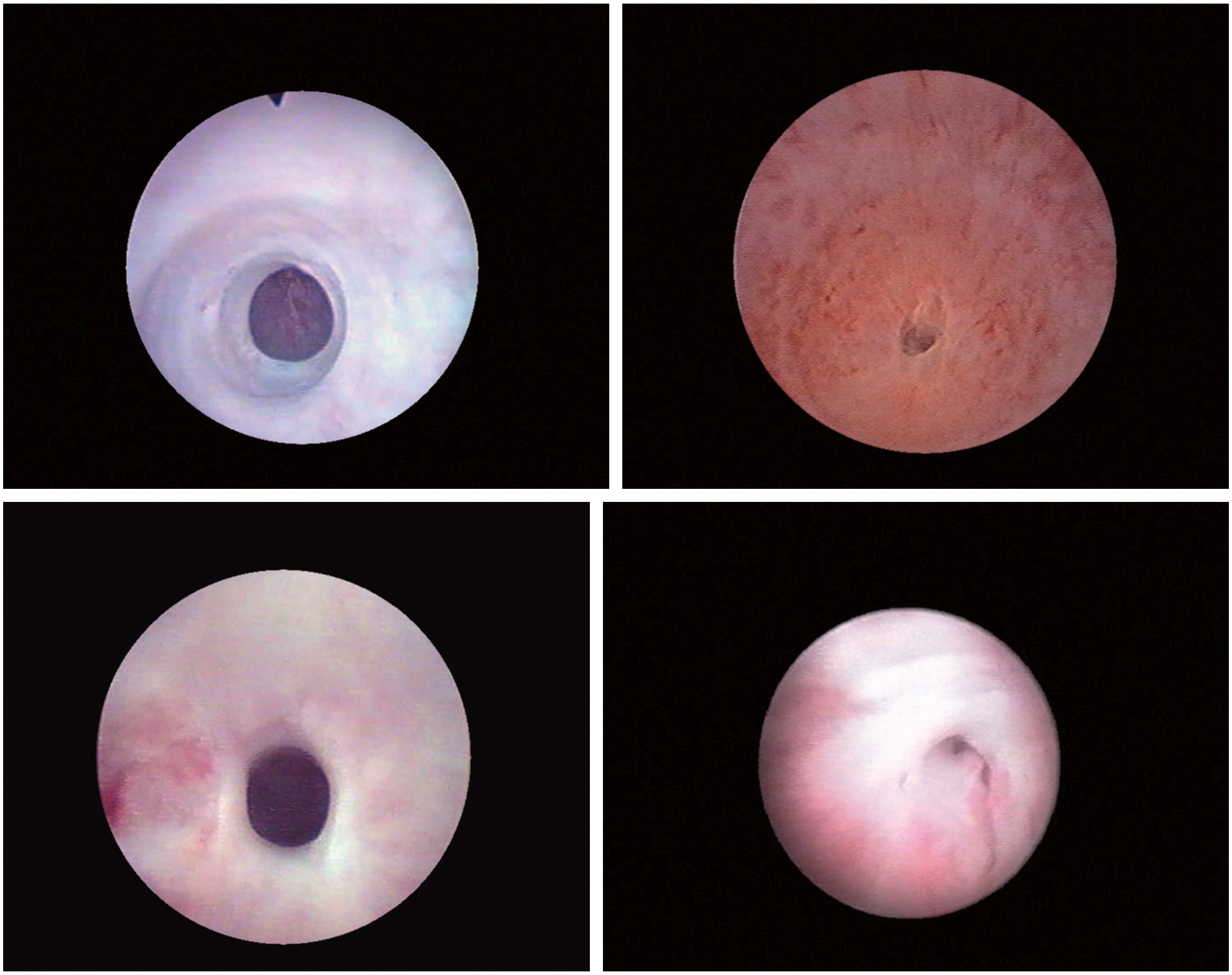

FIGURE 2.62 **Relapsing urethral strictures.**

2.7.3.5 *Diverticula and Urethral Fistulas*

These usually occur after deep incisions between 5 o'clock and 7 o'clock. Most of the fistulas are cutaneous (Figs 2.63 and 2.64), but urethro-rectal fistulas have also been described. Diverticula are rare complications of urethrotomies (Parker et al., 2007). Complete excision followed by urethroplasty represents the treatment of choice for diverticula and fistulas.

2.7.3.6 *Erectile Dysfunction*

The incidence of erectile dysfunction after optical internal urethrotomy varies between 2.2% and 10.6% of cases (Schneider et al., 2001), with several mechanisms: neurogenic (injuries of the cavernous nerves during urethrotomy), vascular (fistulas between corpus spongiosum and corpus cavernosum), or late fibrosis (due to extravasation and septic complications).

2.8 POSTURETHROTOMY MANAGEMENT OF PATIENTS WITH URETHRAL STRICTURE

Different measures have been recommended in order to reduce the risk of relapse after urethrotomy.

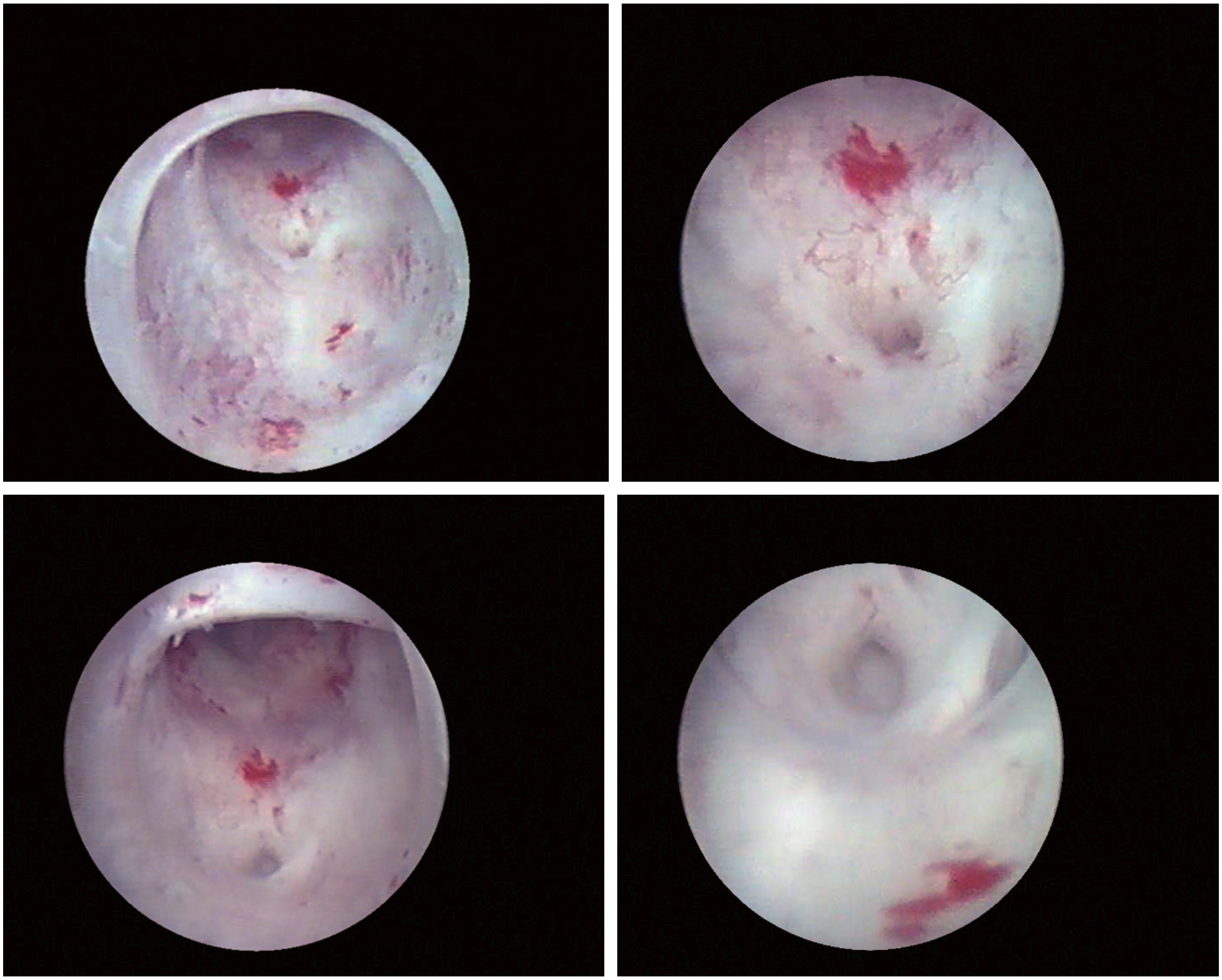

FIGURE 2.63 **Endoscopic appearance of a urethroperineal fistula with the origin in the bulbar urethra.**

2.8.1 Urethral Stenting Interval Adjustment

This is a very controversial issue regarding the endoscopic treatment of urethral strictures. Healing after an endoscopic incision (and extrapolating, even after unpredictable injuries following urethral dilations) is influenced by many factors, including the growth characteristics of the mucosa and underlying tissues, integrity of local vascularization and microvascularization, urinary flow inside the lumen, presence of infections or inflammation, etc. Repair of a discontinuity of the mucosa takes 7–10 days, while 3–5 weeks are necessary after the sectioning of the corpus spongiosum (Weaver, 1962).

The two models of stenting after urethrotomy are based on two different theories. One of these theories states that the reduction of the urinary flow inside the lumen (obtained after urethral stenting) accelerates healing of the incision area without stenosis. According to the second theory, friction of the catheter against the denuded site has a lesional effect and prevents normal re-epithelialization, initiating production of additional spongiofibrosis tissue. Also, the presence of a foreign body (the catheter) may promote infection, while the interaction between tissue and the material from which the catheter is made can initiate inflammation. For these reasons, the catheter is left in place for a period of time varying from 1 day to 6 weeks (Wright, 2004), while some authors recommend no urethral stenting (Dahl and Hansen, 1986).

Another controversial subject is the material from which the Foley catheter is made, as well as its caliber. The urethro-vesical catheters used at present are made from latex, polyurethane, or silicone. Studies regarding reactivity

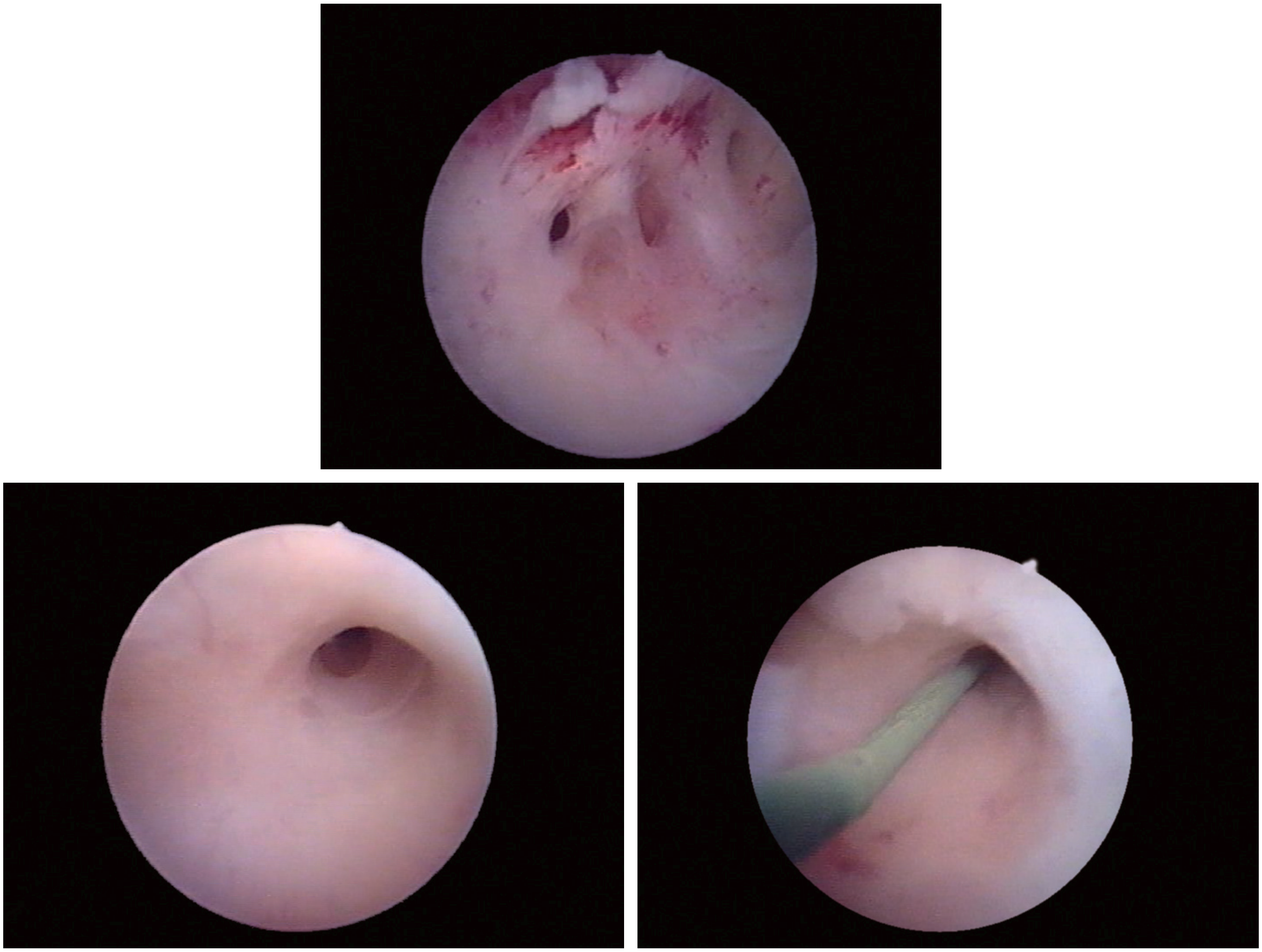

FIGURE 2.64 **Multiple urethroperineal fistulas.**

to foreign bodies have shown that silicone catheters induce less inflammation (Edwards et al., 1983; Talja et al., 1990). At the same time, since their friction coefficient is lower than that of latex catheters, they have the advantage of a faster process of re-epithelialization (Anderson, 1979; Nickel et al., 1987; Robertson et al., 1991).

Regarding the caliber, a 12F stent is sufficient for drainage. For this reason, stents with very high calibers are not recommended in order to avoid putting too much pressure on the urethral walls, which may induce ischemia and prevent re-epithelialization (Edwards et al., 1983).

This is the reason for which Wright and Webster recommend using a 16–20F Foley catheter for no more than 3–5 days after urethrotomy in patients in whom bleeding or extravazation sources exist. In case of complete stenoses, with urethrotomy performed through very intense spongiofibrosis, a 22F catheter may be left in place for 3–6 weeks, to offer support for scar stabilization. The authors also recommend for these situations self-catheterization using catheters up to 22F, to obtain consolidation of the lumen. In their opinion, the urethra may be left without stenting in the absence of important lesions (Wright and Webster, 2004).

Nevertheless, we consider that a medium caliber Foley catheter inserted for a minimum period of time is required for these cases.

2.8.2 Periodical Urethral Dilations

Periodical urethral dilations after optical urethrotomies are recommended especially in patients with important comorbidities or a low life expectancy, and in those with failed urethroplasties in the past (Naudé and Heyns, 2005). Several alternatives of this method have been proposed:

- recalibration using Benique metallic dilators or bougies
- intermittent self-catheterization (Gnanaraj et al., 1999)
- hydraulic autodilation (a manual compression on the glans is used to obtain micturition and to obstruct the fossa navicularis and the urethral meatus) (Mkony, 1999)
- autodilation using balloon catheters (Levine and Engebrecht, 1997)

Hydraulic autodilation has been proposed during the first three to six postoperative months, starting from day 15 after urethrotomy (Lipsky and Hubmer, 1977; Boccon-Gibod and Le Portz, 1982; Pain and Collier, 1984). Nevertheless, some authors do not recommend this method due to extravazation of potentially infected urine through the urethral wound, initiating spongiofibrosis (Hjortrup et al., 1983). The method also carries the risk of genitourinary infections (epididymitis, cystitis, pyelonephritis, etc.), vesico-urethral reflux, hydronephrosis, urinary stones, etc. (Calomfirescu and Voinescu, 2001).

2.8.3 Brachytherapy

Some authors have recommended intraurethral brachytherapy with iridium 192 needles, in total doses ranging from 1000 cGy to 1500 cGy, for preventing production of fibrous scar tissue at the site of the urethrotomy. The applications start during the intervention and are continued or repeated for three consecutive days (Sun et al., 2001; Olschewski et al., 2003; Kröpfl et al., 2004).

2.8.4 Topical Agents

Different types of topical agents have been studied and have shown to reduce the risk of restenosis after urethrotomy:

- topical corticosteroid gel instilled into the urethral lumen 1 week after the intervention (Leyh and Paul, 2005)
- triamcinolone ointment used during intermittent self-catheterization (Hosseini et al., 2008a) or injected into the submucous tissue (Mazdak et al., 2010)
- mitomycin-C as a topical agent (experimental, in animal models) (Ayyildiz et al., 2004) or as submucous injections (Mazdak et al., 2007)
- captopril gel as a topical agent (experimental, in animal models) (Shirazi et al., 2007; Namazi, 2008)
- halofuginone, an oral inhibitor of type I collagen synthesis (experimental, in animal models) (Roehrborn and McConnell, 1994)
- botulinum toxin injected into the posturethrotomy scar, reducing the tonus of the underlying smooth muscle fibers and thus reducing scar retraction (Khera et al., 2004)

2.9 RESULTS

The efficacy of endoscopic treatment for urethral strictures is still a matter of debate. In the short and medium term, optical internal urethrotomy has a success rate between 51% and 95%, decreasing to 28–54% after 60 months. This high variability of the results is influenced by many factors: selection of the patients, type of incision, power source and instruments used, number of procedures, methods (if any) used after the procedure to improve the results, etc.

For cold knife incisions, the success rate at 6 months varies between 51.6% and 95%. Nevertheless, even in the studies with the best results, the success rate dropped dramatically over the long term, to 25% (Giannakopoulos et al., 1997) (Table 2.1).

Lumen et al. (2009), evaluating the results of cold knife urethrotomy in patients with urethral strictures after penile reconstruction, report a success rate of only 43.8% after 51 months, the only significant positive predictive factor being a longer period of time after phalloplasty.

It seems that associating resection of the callus (Fig. 2.65) provides better results compared to only cold incision (Table 2.2). Verges et al. (1990) report a success rate of 55% at 60 months for the combined method, compared with only 28% for Sachse urethrotomy. Giannakopoulos et al. (1997) also records a success rate of 98% for the Guillemin technique compared with 95% for cold incision.

Moreover, it seems that resection of the callus provides more stable long-term results. Thus, in the study of Giannakopoulos et al. (1997) the success rate dropped from 98% at 6 months to 70% at 60 months, a significantly lower reduction compared to cold knife urethrotomy, where the reduction reached 70%.

TABLE 2.1 Results Obtained with Cold Knife Urethrotomy

Authors	Number of patients	Incision type	Success rate (%)	Follow-up (months)
Ruah et al. (1989)	125	Cold knife	57	12–72
Abourachid et al. (1989)	37	Cold knife	78.3	33.5
Khenifar et al. (1990)	33	Cold knife	54	60
Charbit et al. (1990)	69	Cold knife	62.5 27.2	13 71
Verges et al. (1990)	39	Cold knife	28	60
Giannakopoulos and Kammenos (1992)	70	Cold knife	54	60
Prajsner et al. (1992)	178	Cold knife	69.7	–
Benizri et al. (1992)	132	Cold knife	62	18–60
Giannakopoulos et al. (1997)	40	Cold knife	95 85 55 45 25	6 12 24 36 60
Benchekroun et al. (1998)	100	Cold knife	54	12–60
Geavlete et al. (2000)	440	Cold knife	84.3	2–36
Guirrassy et al. (2001)	157	Cold knife	76.8	–
Martov et al. (2002)	86	Cold knife	53.5	–
Hafez et al. (2005)	31	Cold knife	58.1	6.6
Sa et al. (2006)	26	Cold knife	69	6–48
Hosseini et al. (2008b)	43	Cold knife	76.7	24
Hagos (2008)	50	Cold knife	80	–
Lumen et al. (2009)	32	Cold knife	43.8	51

For this reason, plasma electrovaporization of the fibrous callus using bipolar power has been proposed, with encouraging results: a success rate of 77–95% at 1 year (Basok et al., 2008; Zhu et al., 2007). The most probable explanations for the higher efficacy of this method are represented by the complete removal of fibrous tissue and by the limited thermal injuries of the superficial tissues, since the depth of vaporization is of only 118–163 μm, significantly lower than that of monopolar power (287 μm) or Ho:YAG laser (500 μm) (Matsuoka et al., 2002; Wendt-Nordahl et al., 2004; Rassweiler et al., 2007).

Bleeding is minimal compared with cold knife incisions since hemostasis is performed at the same time with the incision, excision, and/or vaporization of the fibrous tissue (Basok et al., 2008). Nevertheless, the incidence of complications seems to be higher after the Guillemin technique than after simple incision. In patients in whom callus resection was also performed, epidydimitis occurred in 10% of patients (compared with 7.5% for Sachse urethrotomy), edema of the penis and scrotum in 12.5%, perineal hematoma in 20%, and extravazation of the irrigating fluid in 40%. Remission of the last three complications occurred within 8 days after the intervention (Giannakopoulos et al., 1997).

Another mode of applying energy for the treatment of urethral strictures is represented by recalibration of the urethral lumen using a balloon with a cutting wire, similar to that used in Accucise™ endopyelotomy. This technique is still experimental and was performed in a small number of patients, but with promising short-term results (Yldirim et al., 2009).

Laser urethrotomy seems to provide higher success rates than cold knife incision, possibly due to the possibility of simultaneous vaporization of spongiofibrosis tissue (Perkash, 1997; Kamal, 2001; Matsuoka et al., 2002; Gürdal et al., 2003; Bancu et al., 2006) (Table 2.3).

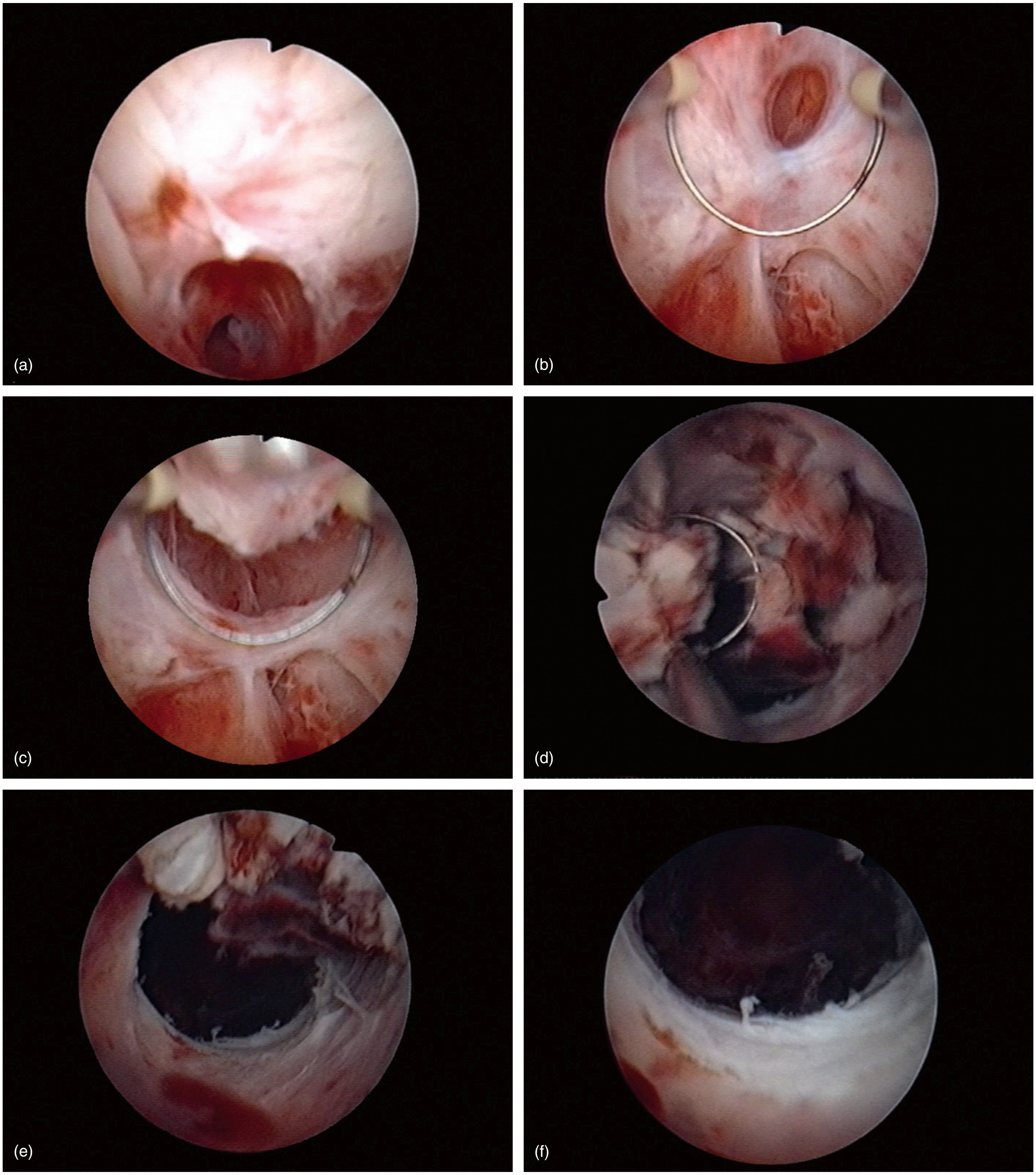

FIGURE 2.65 Stricture of the bulbar urethra (a), treated by transurethral resection of the entire spongiofibrosis process (b–e), obtaining a large lumen (f).

TABLE 2.2 Results of Urethrotomy Associated with Electrovaporization

Authors	Number of patients	Incision type	Success rate (%)	Follow-up (months)
Khenifar et al. (1990)	10	Cold knife + resection	70	60
Gosálbez et al. (1994)	29	Cold knife + resection	72	–
Verges et al. (1990)	34	Cold knife + resection	55	60
Giannakopoulos et al. (1997)	40	Cold knife + resection	98 95 90 80 70	6 12 24 36 60
Zhu et al. (2007)	46	SIPE	95.8	3–18
Basok et al. (2008)	22	PlasmaKinetic™ electrovaporization	77.3	13.8
Yldirim et al. (2009)	4	Balloon with cutting wire	100	6

The theory according to which laser urethrotomies have a lower rate of postoperative generation of fibrous tissue and implicitly a lower risk of relapse supports the use of this method (Bloiso et al., 1988).

Although for Nd:YAG laser (with a higher tissue penetrability of 4–5 mm) the incidence of relapses does not seem to be significantly lower compared to cold knife urethrotomy (Smith, 1989), the Ho:YAG laser (which has a superficial absorption of approximately 0.5 mm) has a minimal impact on the surrounding tissues (Kamp et al., 2006). Even for the Nd:YAG laser, Bloiso et al. (1988) report a success rate of 96.8% for simple strictures, but of only 22.9% for complicated ones.

While the superiority of lasers compared with cold knife incision is challenged by some authors, a possible explanation for the similar relapse rates is the multifactorial mechanism involved in the recurrence of urethral strictures.

TABLE 2.3 Results of Laser Urethrotomy

Authors	Number of patients	Incision type	Success rate (%)	Follow-up (months)
Adkins (1988)	13	Argon	78	–
Shanberg et al. (1988)	20	KTP 532	68.2	6–14
Bloiso et al. (1988)	79	Nd:YAG	51.9	10
Becker et al. (1995)	450	Argon	50 29.9	12 15.2
Schmidlin et al. (1997)	13	KTP 532	81	6
Kural et al. (2000)	13	Ho:YAG	69	27
Dogra and Nabi (2002)	65	Nd:YAG	93.8	9–44
Matsuoka et al. (2002)	28	Ho:YAG	74	–
Gürdal et al. (2003)	21	Nd:YAG	76 67 52	6 12 24
Dogra (2004)	29	Ho:YAG	65.5	15
Hossain et al. (2004)	30	Ho:YAG	90	6–12
Kamp et al. (2006)	32	Ho:YAG	75	27
Geavlete et al. (2006)	31	Nd:YAG	77.4	23
Xiao et al. (2008)	38	Ho:YAG	94.7	3–18
Martov et al. (2007)	644	Laser, cold knife, or electric	80.4	12

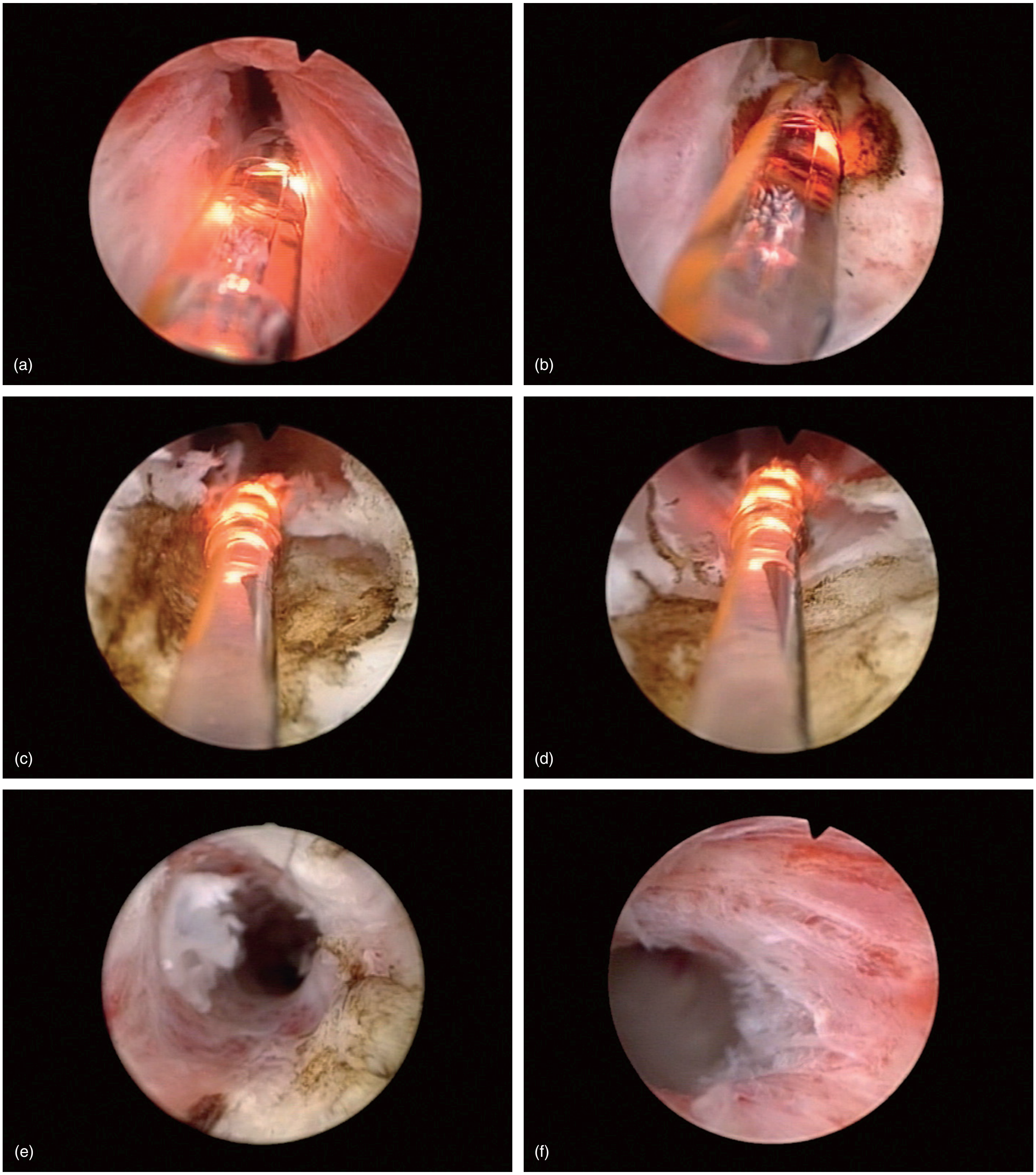

FIGURE 2.66 **Urethral stricture (a), vaporization of spongiofibrosis tissue using the diode laser (b–d) until a large lumen is obtained (e, f).**

As in the case of plasma vaporization, incision and laser ablation of spongiofibrosis are accompanied by hemostasis (Fig. 2.66) thus reducing the complications rate for laser urethrotomies compared to cold knife urethrotomy (Kamp et al., 2006).

However, lasers with high tissue penetrability have a risk of perforations, fistulas, or inflammation of the rectal mucosa (Shanberg et al., 1984). The success of urethrotomy also depends on whether it is a primary or a secondary procedure. With every incision, fibrosis is initiated in the spongiosa and, for this reason, the highest success rates are recorded in case of incision of strictures at their first clinical manifestation. The success rate drops dramatically starting with the third procedure, and for this reason it is not recommended to continue with endoscopic treatment. Heyns et al. (1998) reported unfavorable results at 24 months in all patients with a third urethrotomy or urethral dilation.

Another method for improving results of incisions is represented by ultrasound guidance and identifying the location and extension of the spongiofibrosis process (Cauni et al., 2006). In a study performed by Mitterberger and coworkers, a better correlation between ultrasound findings and the histologic parameters of the strictures was recorded compared to radiological exams. Thus, the correlation coefficient was 0.92 for the length of the stricture measured by ultrasound, compared with only 0.72 for retrograde urethrography. The differences between the two methods were lower in case of strictures of the penile urethra (correlation coefficient of 0.98 and 0.91, respectively) and highest for the bulbar urethra (correlation coefficient of 0.92 and 0.65, respectively) (Mitterberger et al., 2007). Geavlete et al. (2000), in a study on 440 patients with urethral strictures treated by cold knife urethrotomy after determining the position of the incisions by ultrasound, report a low relapse rate of only 15.7%.

Doppler ultrasound also identified abnormal positions of the bulbourethral arteries in all patients with urethral strictures. Anomalies were represented by asymmetries, no visible flow in one or both of the arteries, as well as a decrease of the distance between the vessels and the urethra from 2.67 mm in healthy individuals to 1.88 mm. It is possible to lower the risk of complications if these anomalies are identified before the procedure (Chiou et al., 1998; Kishore et al., 2005).

A rigorous patient selection is probably the best method for optimizing the results of urethrotomy. Positive predictive factors for the success of endoscopic treatment are (Pansadoro and Emiliozzi, 1996; Gürdal et al., 2003; Leyh and Paul, 2005):

- single strictures
- area of stenosis shorter than 1 cm
- stricture of the bulbar urethra
- large strictures, with a lumen caliber higher than 15F
- primary strictures

In a retrospective study on 139 patients treated by optical internal urethrotomy, Zehri et al. (2009) identified the following predictive factors for relapse: strictures of the penile urethra, strictures after transurethral resection of the prostate, and stenoses longer than 2 cm; thus, Zehri recommends avoiding endoscopic incision as a sole therapy for these cases.

There are no studies demonstrating that the material from which the urethro-vesical catheters placed after the procedures are made influences the relapse rates. Nevertheless, silicone catheters were used in the majority of recent studies.

Different alternative methods have been evaluated for postoperative consolidation of treatment. Intermittent catheterization using a lubricant with triamcinolone reduced the restenosis rate from 44.1% to 30% after one urethrotomy and from 40% to 11.1% after two procedures. However, these differences were not statistically significant and additional studies are needed (Hosseini et al., 2008a).

Lauritzen et al. (2009) reported, after a follow-up of 3–6 years, a reduction of the relapse rate from 31% to 9% in patients in whom optical urethrotomy was followed by a program of intermittent self-catheterization.

Brachytherapy with iridium 192 has also shown promising results in preventing relapses in patients with urethral strictures previously treated by endoscopy, the relapse rates being decreased to 7–40% after a median follow-up ranging from 15 months to 22 months (Sun et al., 2001; Kröpfl et al., 2004; Olschewski et al., 2003).

Mazdak et al. (2007) report a decrease of the relapse rate from 50% to 10% after submucosal injection of mitomycin-C at the site of the urethrotomy. Submucosal injection of triamcinolone also led to a decrease of the relapse rate from 50% to 21.7% (Mazdak et al., 2010). However, these adjuvant methods have not yet been adopted on a large scale in everyday practice, and additional studies are necessary to demonstrate their real clinical benefit.

Regarding endourethroplasty, the available studies report promising results (Pettersson et al., 1978; Rosin and Edwards, 1979; Gaur, 1983; Zhang et al., 1989; Naude, 1998; Dong et al., 2009).

The rate of fixation of the graft varies in the literature between 95% and 100% (Pettersson et al., 1978; Gaur, 1983; Naude, 1998).

Farahat and Elbahnasy, using patches made from small intestinal submucosa in 10 patients, report a success rate of 80% at 3 months. Even in the other two patients (who had the longest strictures that relapsed after the first optical internal urethrotomy), the restenoses were mild. The authors consider that posttraumatic etiology, a dense spongiofibrosis process and strictures longer than 2 cm represent negative predictive factors for a successful endoscopic urethroplasty (Farahat et al., 2009).

Two years after endoscopic urethroplasty with skin graft, Naude (1998) reports a patent lumen in 100% of inflammatory and iatrogenic strictures, in 50% of posttraumatic strictures associated with pelvic bone fractures, and in 75% of strictures developed after urethral ruptures treated after 2–3 weeks from the trauma.

Some authors have reported modest results for this technique. After endoscopic urethroplasty with a graft made from collagen matrix obtained from the small intestinal submucosa, Le Roux reports the absence of restenosis in only three out of the eight patients treated (one of them requiring periodical dilations).

However, of the five patients with treatment failure, two presented posttraumatic strictures, while one patient had an inflammatory stricture, but longer than 3 cm. Also, the extension of the spongiofibrosis process was not evaluated by ultrasound in any of these cases (Le Roux, 2005).

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CHAPTER

3

Urethral Stents

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3.1 HISTORY

The first descriptions of urethro-vesical catheters date back to antiquity, when straws or palm leaves were used for this purpose. In China, Sun Shimiao (581–682 AD) used tubular leaves from green onions through which air was blown to remove the obstacle (Wang and Thompson, 2009). In 1036, Avicenna sensed the need for gentle insertion of catheters and created flexible models from animal skin, treated with ox blood for firmness and lubricated with cheese (Wang and Thompson, 2009).

Joseph Frederick Benoit Charriere developed a scale for measuring the caliber of urological instruments and catheters, promulgated by the French Academy of Sciences in 1799, each unit (named Ch – Charriere – in Francophone literature, and F – French – in Anglo-saxon literature) representing 1/3 mm.

The discovery of vulcanization by Goodyear in 1839 made it possible to create resistant and flexible rubber stents much more adequate for their purpose. In the following period of time, Auguste Nelaton created the namesake catheter.

After a series of failed attempts (Reyland, Lebreton, Desnos, Holt, Dowse, Herman Odolo, etc.), in 1937 Foley (together with Bard and then Anode Company) developed the autostatic urethro-vesical catheter, which is still used today (Mattelaer, 1996).

The next logical step was the development of a prosthesis, which, inserted into the urethra, would achieve recalibration only for the stenosed segment. The first reports of stents being used to treat benign prostatic obstruction date back to the 1980s (Fabian, 1980). Subsequently, the indications for mounting stents in the lower urinary apparatus were diversified, including also the treatment of vesico-sphincterian dyssinergia or of urethral strictures. Complications of temporary stents (incrusting, infections, etc.), as well as discovery of the phenomenon of epithelialization of network-type prostheses (application of radial expansion force on the urethral wall) led to the development in 1987 of permanent stents such as UroLume® (AMS, Minnetonka, MN, USA) (Milroy et al., 1988).

In an attempt not to leave a foreign body in the urethra, with all its inconveniences, and also to avoid extraction of the stents, which is sometimes difficult or even impossible to perform, bioabsorbable urethro-prostatic prostheses were developed. The first such devices used for the treatment of urethral strictures were proposed by Kemppainen in an experimental study in 1993 (Kemppainen et al., 1993).

3.2 GENERALITIES

Urethral and prostatic stents were developed as an alternative to conventional surgical techniques for treating subvesical obstacles. The method's principle consists of creating a "bypass" which restores urinary flow of the inferior urinary apparatus by mounting a tubular structure (the stent) from the urethral segment overlying the obstacle to the segment underlying it.

The performance criteria for stents were established during the third International Consultation on Benign Prostatic Hyperplasia, in 1995. Thus, an ideal model should be:

- easy to insert (blind, without visual or radiologic control)
- easy to extract when necessary

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- stabilized at both ends for preventing migration
- with thin walls, for a minimal urodynamic resistance
- soft and flexible for the patient's comfort
- resistant to incrusting
- efficient in improving symptoms of the inferior urinary apparatus
- should allow maintenance of continence
- should not be aggressive against tissues
- associated with a urinary tract infection rate lower than intermittent or permanent urethro-vesical catheterization
- cheap.

3.3 URETHRAL STENT CLASSIFICATION

In order to accomplish the intentions enunciated in the first part of this chapter, a large palette of stents has been developed in the last decades for use in urethral and prostatic disorders.

Stents may be classified into permanent and temporary (Ogiste et al., 2003).

Permanent stents, such as UroLume (AMS, Minnetonka, MN, USA) (Fig. 3.1), Ultraflex® (Boston Scientific, Natick, MA, USA), or Memotherm® (Bard, Covington, GA, USA), allow for tissue growth toward the lumen, with their progressive epithelialization and embedding in the urethral wall (Madersbacher, 2006) (Table 3.1). The principle on which their placement is based is represented by creation of a structure in which the stent reinforces the urethra, the most correct analogy being with reinforced concrete.

This leads to a theoretical reduction in the risk of urinary infections, migration, and incrusting, but presents some disadvantages: difficult removal (when this is necessary) and, over time, reduction of the luminal diameter.

Temporary stents such as Memokath (Engineers & Doctors A/S, Hornbaek, Denmark), Urethrospiral® (Mentor/Porges), and Allium® (Allium Medical, Caesarea, Israel) prevent epithelialization, allowing their easy removal

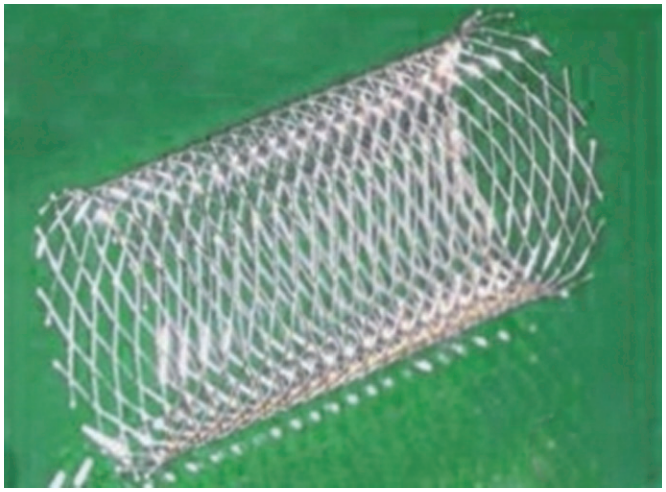

FIGURE 3.1 **UroLume type permanent metallic stent (AMS, Minnetonka, MN, USA).**

TABLE 3.1 Particularities of the Different Models of Permanent Urethral Stents

Models	Manufacturers	Types	Caliber (F)	Length (mm)
UroLume	AMS	Self-expandable	42	20–40
Memotherm	Bard	Thermoexpandable	42	20–80
Ultraflex	Boston Scientific	Self-expandable	42	20–50

TABLE 3.2 Particularities of the Different Models of Temporary Urethral Stents

Models	Manufacturers	Types	Caliber (F)	Length (mm)
METALLIC STENTS				
Memokath 044®	Engineers & Doctors A/S	Thermoexpandable	24/44	30–90
Memokath 045®	Engineers & Doctors A/S	Thermoexpandable	24/44	5–70
Urethrospiral	Mentor/Porges	Nonexpandable	21/30	40–70
UroCoil		Self-expandable	24/30	40–80
UroCoil-S		Self-expandable	24/30	40–80
UroCoil Twin		Self-expandable	24/30	40(50), 50(50)
Allium	Allium Medical	Self-expandable	22/45	
POLYURETHANE STENTS				
Nissenkorn		Autostatic basket	16	30–40
BIODEGRADABLE POLYGLYCOLIC ACID STENTS				
Biofix	Bionx Implants			

whenever necessary (Table 3.2). These stents play the role of matrix for stabilization of spongiofibrosis tissue and of preventing cicatriceal retraction, leaving a large, remodeled lumen after extraction (Fig. 3.2). These stents may be maintained over a variable period of time, depending on the model: from 12 to 14 months (Urethrospiral, Allium, Nissenkorn) to 36 months (UroCoil®, Memokath) (Yachia, 2004; Nissenkorn and Shalev, 1997).

Depending on the materials from which they are manufactured, these may be classified into:

- metallic stents
- polyurethane stents
- polyglycolic or polylactic acid stents.

These classes of stents have different particularities determined by design and biodegradability.

First generation spiral metallic stents, such as Urethrospiral, were made of stainless steel. Subsequently, development of modern alloys such as nithinol (nickel–titanium) allowed the creation of second-generation metallic stents, such as Memokath, UroCoil, Ultraflex, and Memotherm (Madersbacher, 2006).

Polyurethane stents were developed as an alternative to metallic stents, this material being however used in the manufacture of models used in prostatic disorders.

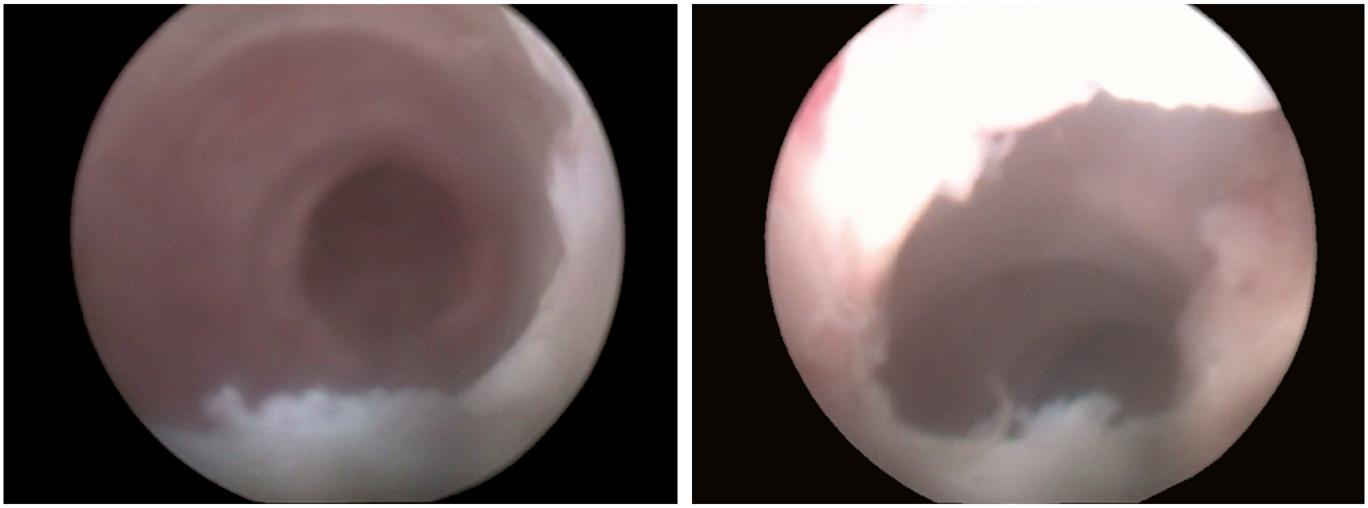

FIGURE 3.2 **Large aspect of the urethral lumen after extracting a Memokath temporary stent.**

Polyglycolic or polylactic acid stents are biodegradable (Pétas et al., 1998). The properties of the constituent polymers allow expansion of the stents by 70% compared with the initial diameter (50% in the first 30 min) (Talja et al., 1997). Polyglycolic acid stents are already commercially available, while polylactic acid stents for use in urology are still under development.

Depending on how they are locked in the desired position, stents may be self-expandable (UroCoil, Urolume, Ultraflex), thermoexpandable (Memotherm, Memokath 044), or nonexpandable (Urethrospiral).

3.4 INDICATIONS

Regarding urethral diseases, stenting is indicated in selected cases of strictures. Also for this pathological entity, as in the case of prostatic diseases, initial enthusiasm has been replaced by a more reserved attitude, the indications currently being limited.

The explanation probably lies in the fact that the long-term results of stenting have been relatively disappointing compared with those of urethroplasty, a procedure currently performed on a large scale in urology centers (Palminteri, 2008).

The indications of this method are represented by bulbomembranous strictures with moderate fibrosis and a short evolution (after at least one urethrotomy or dilation, but before multiple such procedures, which can generate important fibrosis). Short uninstrumented strictures or those secondary to trauma or to urethroplasties will not be stented, because these are almost always accompanied by extensive fibrosis (Milroy, 1998) (Figs 3.3 and 3.4).

Palminteri suggests an even stricter selection of patients who are candidates for stenting, thus including only those in whom another type of urethral surgery cannot be performed. The reason for this additional limitation is represented by the risk, due to stimulation of the hyperplastic growth of urethral tissue, of transforming a simple stricture into a complicated one, which would require complex surgical interventions in several steps (Palminteri, 2008).

If possible, endoprosthesis of distal bulbomembranous strictures should be avoided, due to the painful symptomatology determined by the presence of the stent (while sitting, during sexual intercourse, etc.).

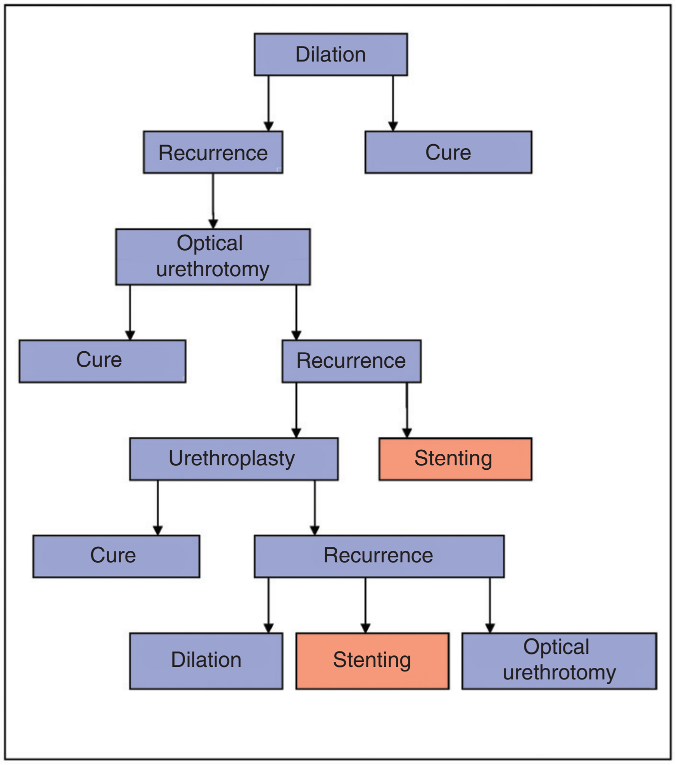

FIGURE 3.3 **Treatment algorithm of urethral strictures before 1990 (blue) and after 1990 (blue and red).** *Modified from Yachia (2004).*

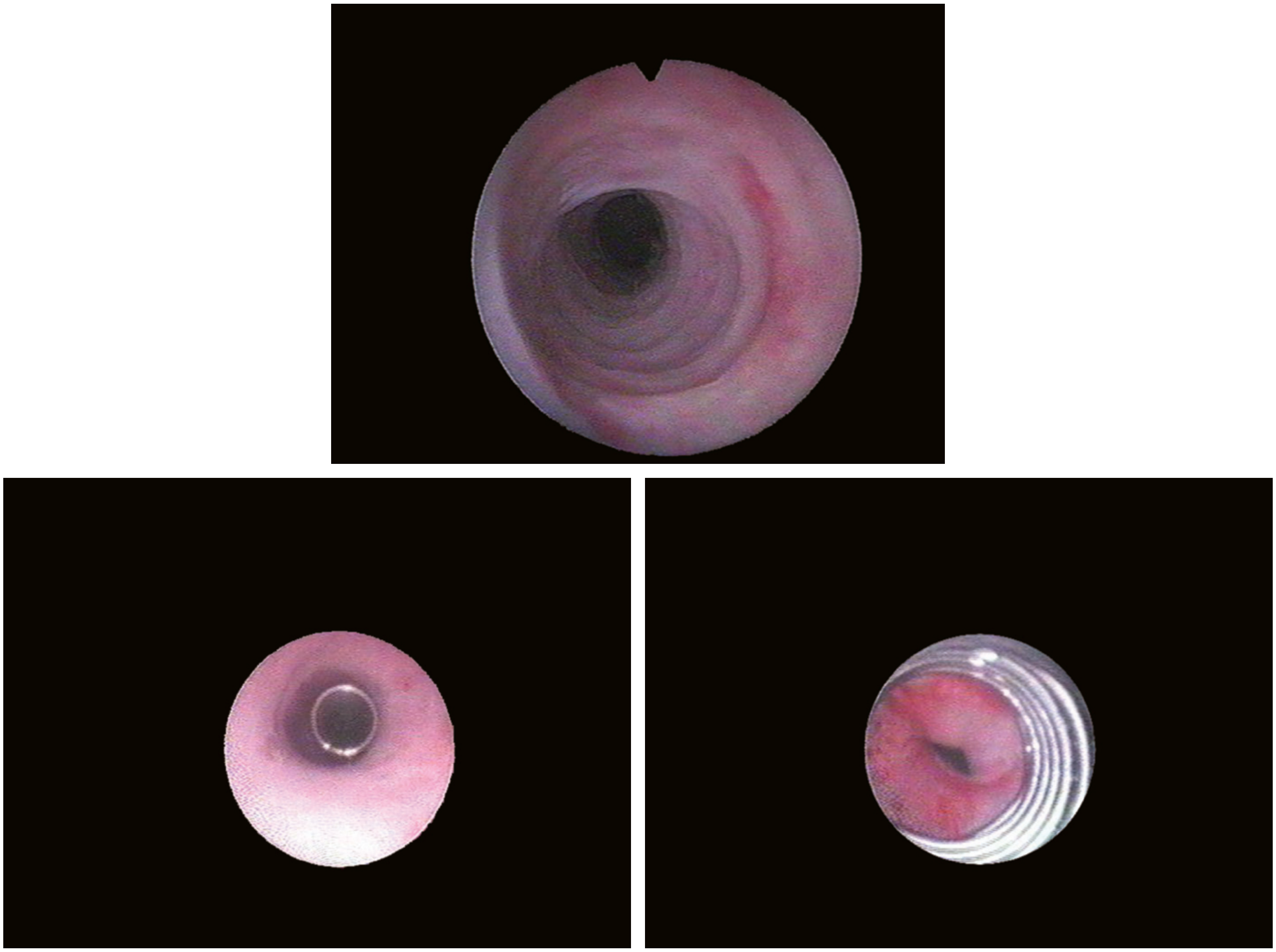

FIGURE 3.4 **Bulbar stricture for which a Memokath type temporary metallic stent was placed.**

3.5 TECHNIQUE

3.5.1 Anesthesia

Stents may be placed under local anesthesia, which is an important element when taking into account the selection criteria of patients who are candidates for this type of procedure (elderly, with important comorbidities) (Breda et al., 1994).

3.5.2 Positioning of the Patient

Stents are placed with the patient in the classical position for lithotomy, adequately draped with sterile fields.

3.5.3 Intervention Control

All permanent stents are placed under endoscopic control. Of the temporary stents, models such as Memokath, Biofix®, Urethrospiral, etc. can be placed under direct visual control. Insertion of stents can also be performed under fluoroscopic control (Memokath, Urethrospiral, UroCoil, etc.), under ultrasound control (Prostakath), or under manual control without guidance (Trestle).

3.5.4 Urethrocystoscopy

This represents the first operative step, with the purpose of evaluating the morphology of the urethra, and, if possible, of excluding the existence of associated diseases (tumors, lithiasis, etc.).

3.5.5 UroLume Stent

The UroLume stent is a self-expandable permanent stent made out of a network of "superalloy" fibers (a complex alloy based on chromium, nickel, molybdenum, and cobalt), which can be used in bulbomembranous strictures. The stent has a length of 20 or 30 mm, and a diameter in its expanded form of 42F. This model is placed with the help of a special applicator.

Recalibration of the urethra must be performed by dilation or urethrotomy up to a diameter of 26–30F.

The length of the stricture is measured either by fluoroscopy, with retrograde urethrography, or visually by marking the sheath of a cystoscope. One centimeter is added to the measured distance, so that the two ends of the stent can reach 0.5 cm cranial and 0.5 cm caudal into healthy lumen.

The applicator, equipped with a 0° telescope, is inserted until it surpasses the proximal portion of the stricture. Expansion of the stent makes it shorter, so enough space should be left between the distal portion of the applicator and the stricture. Once the applicator is in the correct position, the first safety is opened and the external metallic sheath starts to be withdrawn, releasing the proximal end of the stent. If a caudal movement of the stent is required, this is done by withdrawing the applicator. If a cranial repositioning is necessary, the external sheath is pushed back into place and only then is the device pushed up the urethra. In order to avoid a potential proximal movement of the stent, which is evidently more difficult to correct, some authors start to release it 5 mm from the external sphincter and then they pull it distally, until its cranial end reaches the desired position (Shah and Badlani, 2004).

When certain of a correct positioning, the second safety is opened and the metallic sheath is completely withdrawn, followed by expansion of the entire stent.

In the case of strictures longer than 2.5 cm or of multiple strictures, several UroLume stents can be placed serially (Tillem et al., 1997).

It is not necessary to insert a urethro-vesical catheter after placing the stent.

Removal of the stent in the period following its insertion is done by pulling on the caudal end with a solid tweezer. This maneuver increases tension in the fibers, with narrowing of the lumen and extraction of the stent, with minimal trauma to the urethra.

Complete epithelialization of the stent takes place after 4–6 months, and the stent is embedded into the urethral wall 12 months after the intervention (Milroy et al., 1989; Lymberopoulos et al., 1992).

Once the stent has been covered with epithelium and embedded into the wall, removal of the stent is done in the vast majority of cases by surgical excision with urethral reconstruction (Parsons and Wright, 2004; Milroy, 2004; Elkassaby et al., 2007). Cases have been reported in which Ho: YAG laser was used for excision of the intraluminal tissue followed by transurethral extraction of the prosthesis (Gupta and Ansari, 2004) or even for sectioning the metallic network into pieces for an easier removal (Kural et al., 2001).

3.5.6 Memokath Stents

The equipment necessary for the intervention consists in:

- Memokath 044 TW (for bulbar urethra), 045 TW, or 045 TTW (for penile urethra) insertion kit
- Rigid or flexible cystoscope
- Local anesthetic gel
- 100 mL Guyon type syringe
- 50 mL of sterile water heated to 55°C
- Thermometer for checking the water's temperature.

Memokath 044 stents, used in strictures of the bulbar urethra, may have lengths of 30, 40, 50, 60, 70, 80, or 90 mm, while their diameter ranges from 24F (before expansion) to 44F (at the cranial end, after expansion). Memokath 045 (TW or TTW), indicated in the treatment of penile urethra strictures, may have lengths of 5, 10, 20, 30, 40, 50, 60, or 70 mm, while their diameter is also 24/44F (Fig. 3.5). Both ends expand in the Memokath 045 TTW stent, the cranial end from 24F to 44F, and the caudal end from 24F to 34F (Fig. 3.6).

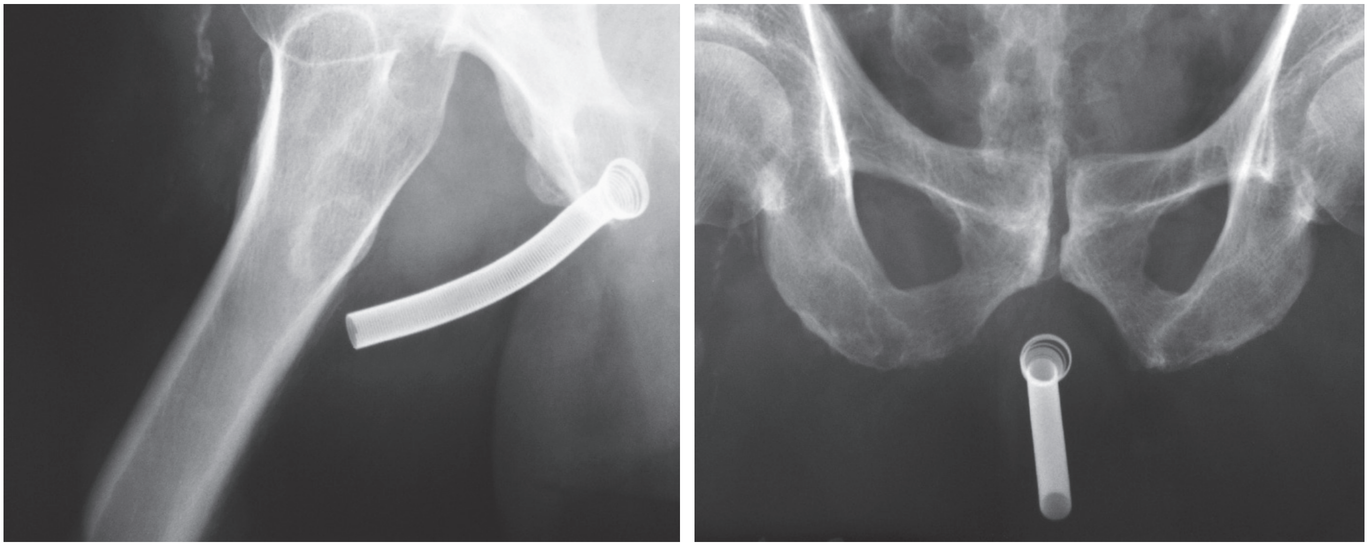

FIGURE 3.5 **Memokath 045 TW stent, expanded only at one end.**

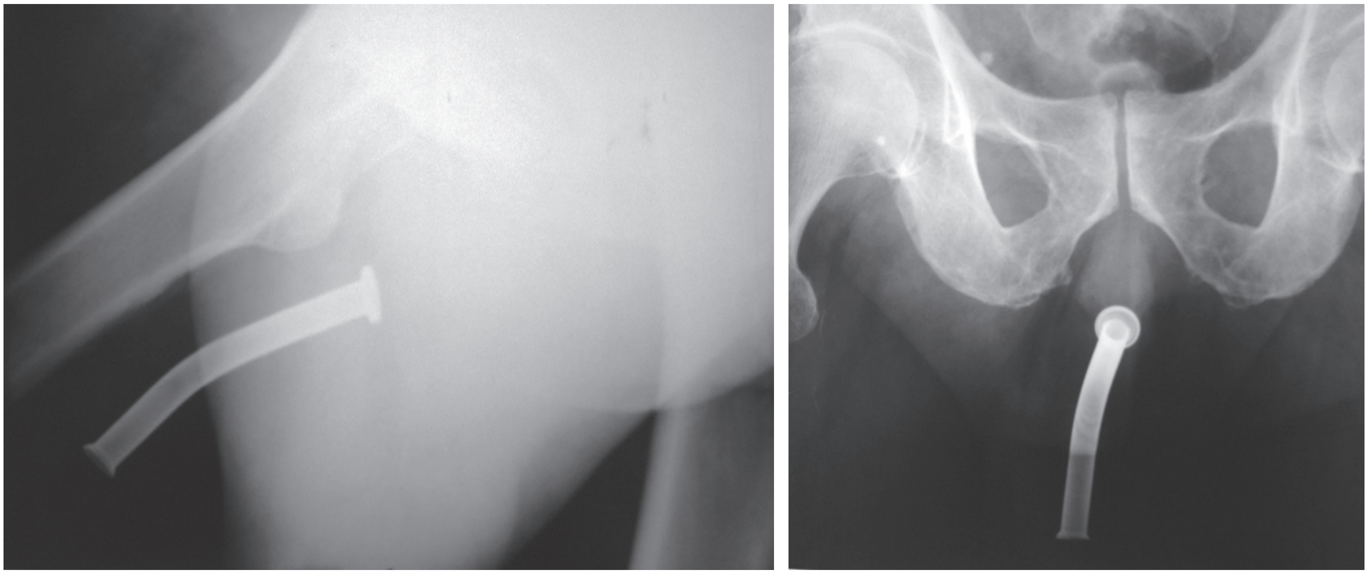

FIGURE 3.6 **Memokath 045 TTW urethral stent, expanded at both ends.**

It is recommended to have stents with all the standard dimensions at your disposal at the moment of the intervention; the choice of the stent that is used being made intraoperatively. Memokath 044 TW stents can be used in the treatment of strictures of the bulbar urethra, with thermosensible expansion at the cranial end. For the penile urethra, Memokath 045 TW can be used, which presents thermosensible expansion of the coils at the cranial end, as well as 045 TTW in which this phenomenon takes place at both ends.

The length of the stricture is evaluated under visual control by applying metallic clips on the sheath of the cystoscope, with its distal end positioned at the level of the proximal and, subsequently, distal extremity of the stricture (Fig. 3.7).

Usually, a stent which is 2 cm longer than the stricture is chosen, so it may be positioned 1 cm cranial and 1 cm caudal in the normal urethra. In the case of bulbar strictures, a stent which is 2–3 cm longer than the measured distance is chosen to prevent occurrence of a secondary stricture at its caudal end. After the two determinations, the adequate length of the stent is chosen, taking into account the fact that after positioning and expansion, the length decreases by approximately 4 mm.

In the case of broad strictures (especially in patients with previously inserted urethro-vesical catheters), it is enough to recaliber them up to 24F, using a dilator provided by the manufacturer together with the stent. In the case of tight strictures, it may be necessary to perform optical internal urethrotomy together with stellate incisions before stenting (Fig. 3.8).

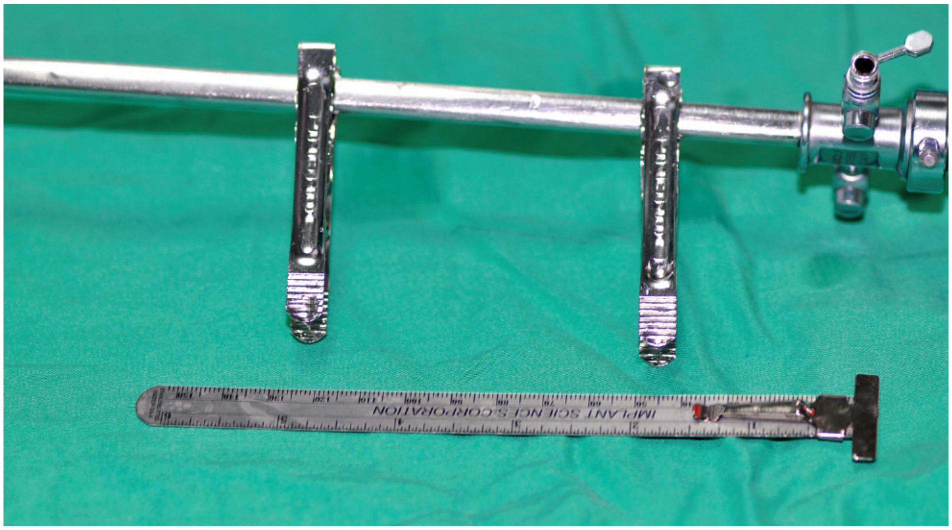

FIGURE 3.7 **Evaluation of the stricture's length by applying metallic clips on the sheath of the urethrocystoscope and measuring the distance between them.**

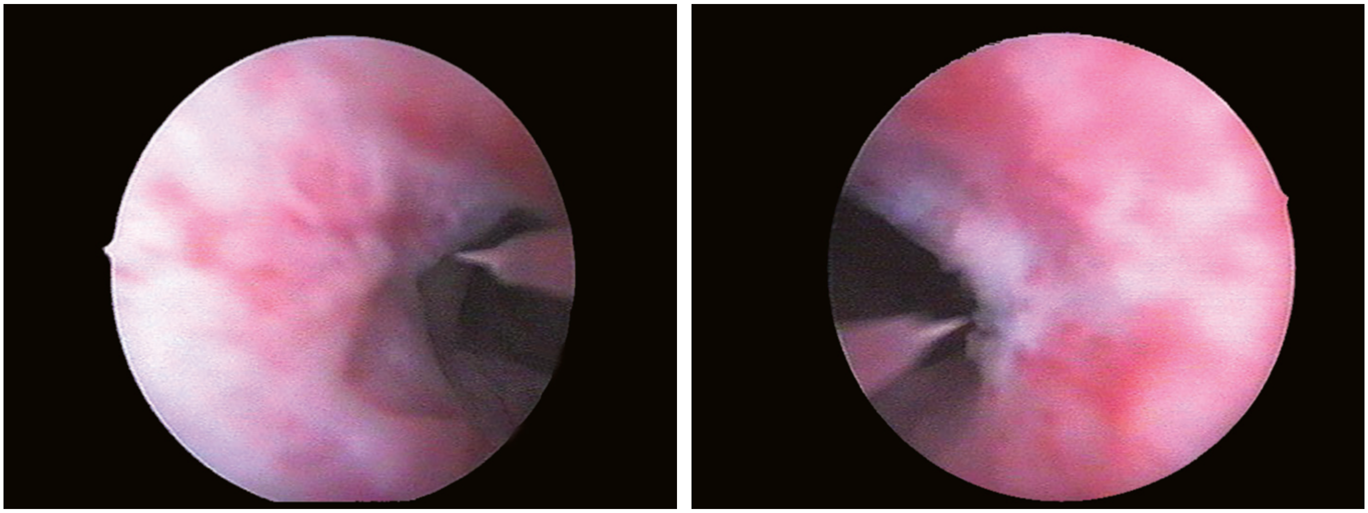

FIGURE 3.8 **Stellate incision of the urethra before placing the urethral stent.**

A 0° optical telescope is attached at the level of the insertion system, delivered together with the stent (Fig. 3.9). Transurethral insertion of this device is performed under direct visual control, its distal end being positioned at the level of the cranial extremity of the stricture (Fig. 3.10). Subsequently, 50 mL of saline solution heated to 55°C is injected to expand the end/ends of the stent (Fig. 3.11). After extracting the insertion system, the correct position of the prosthesis is verified radiologically and visually (Fig. 3.12). An incorrect positioning of the stent can be corrected with the help of the urethrocystoscope or of the semirigid ureteroscope which is transluminally inserted (Geavlete et al., 2007) (Fig. 3.13).

If, for some reason, it is necessary to extract the stent, this may be easily done by injecting 50 mL sterile water at 5°C, after which the distal end is caught with a forceps (Fig. 3.14). Due to these maneuvers, the spirals of the stent disorganize (Fig. 3.15) and a metallic "wire" results in the end (Fig. 3.16).

3.5.7 UroCoil Stents

Three types of such stents exist:

- UroCoil – made of a single spiral segment, indicated for stenting postbulbar strictures along the entire penile urethra

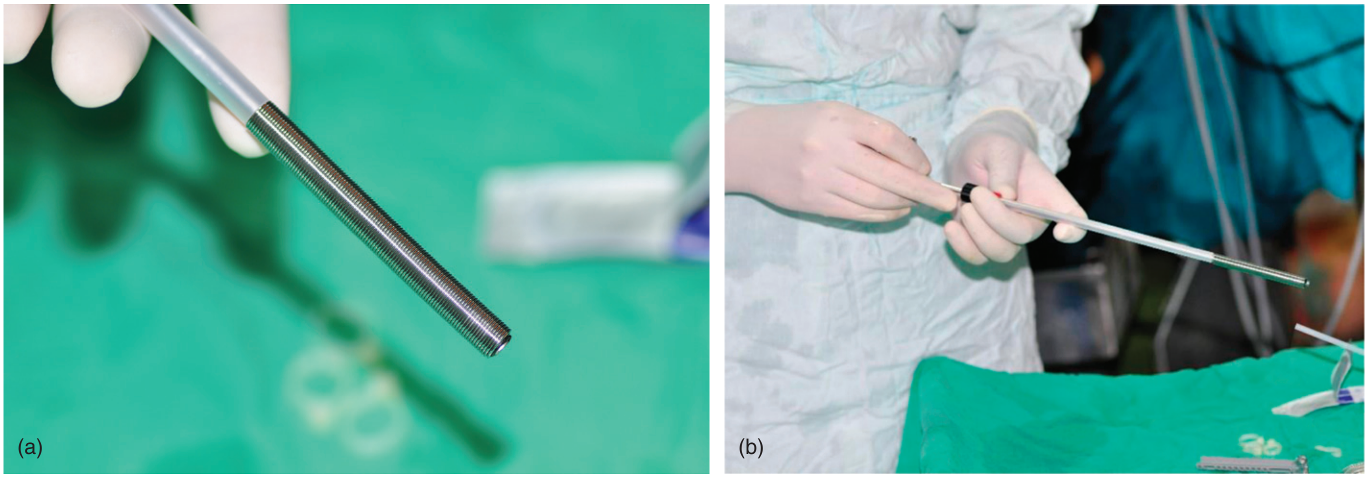

FIGURE 3.9 Memokath stent application system (a), to which a 0° optical telescope is attached (b).

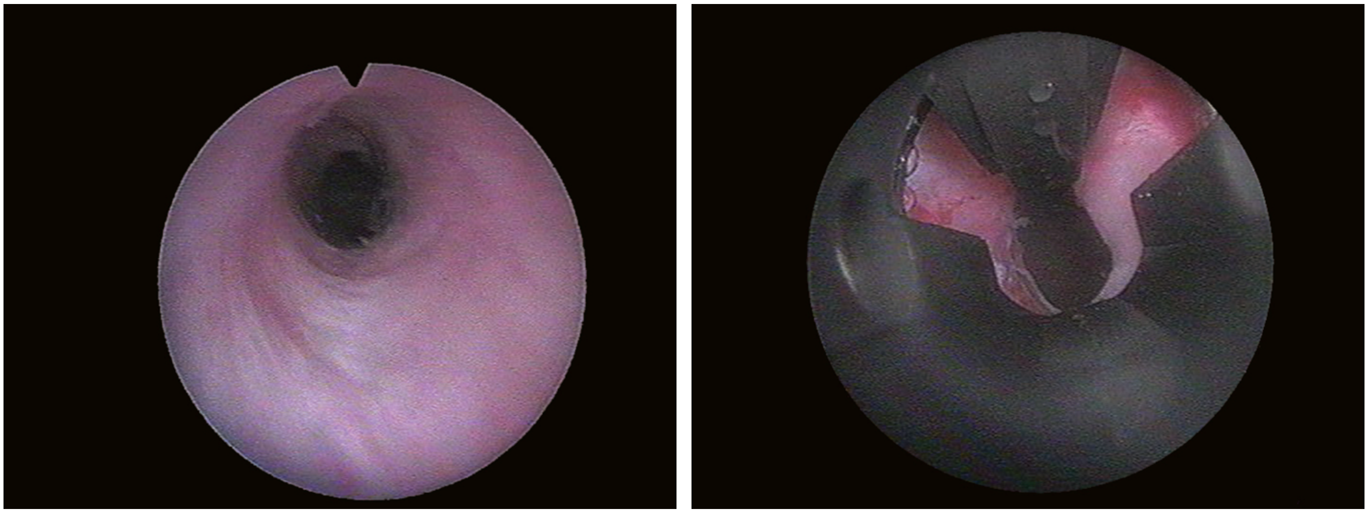

FIGURE 3.10 Positioning of the stent at the urethral level.

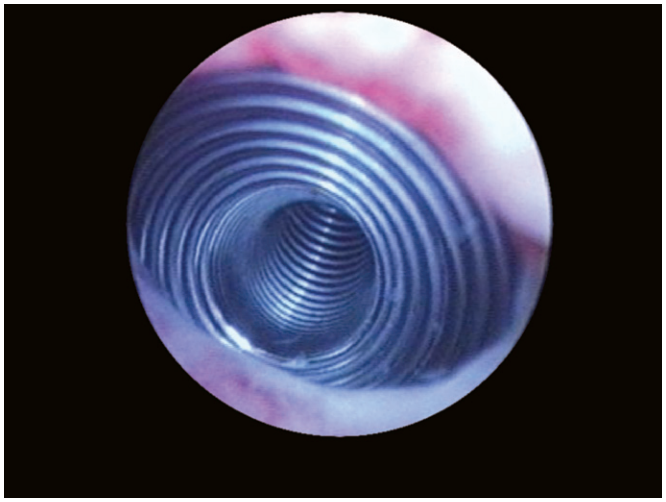

FIGURE 3.11 Endoscopic aspect of the expanded end of the stent.

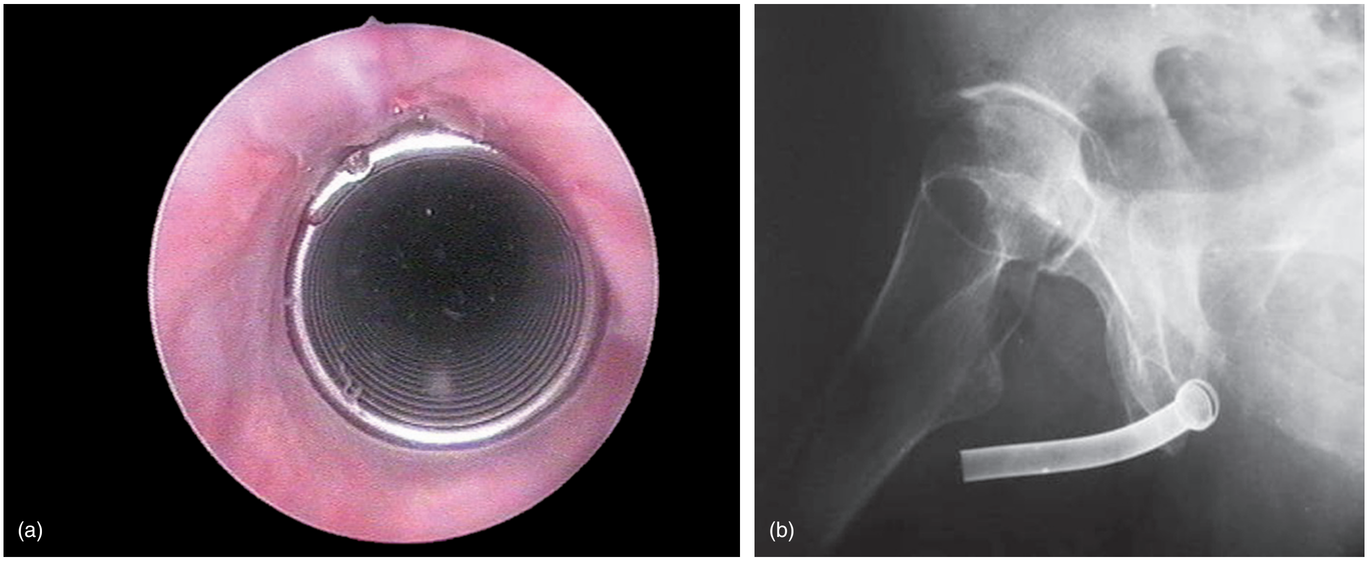

FIGURE 3.12 **Endoscopic (a) and radiologic (b) verification of the stent's position.**

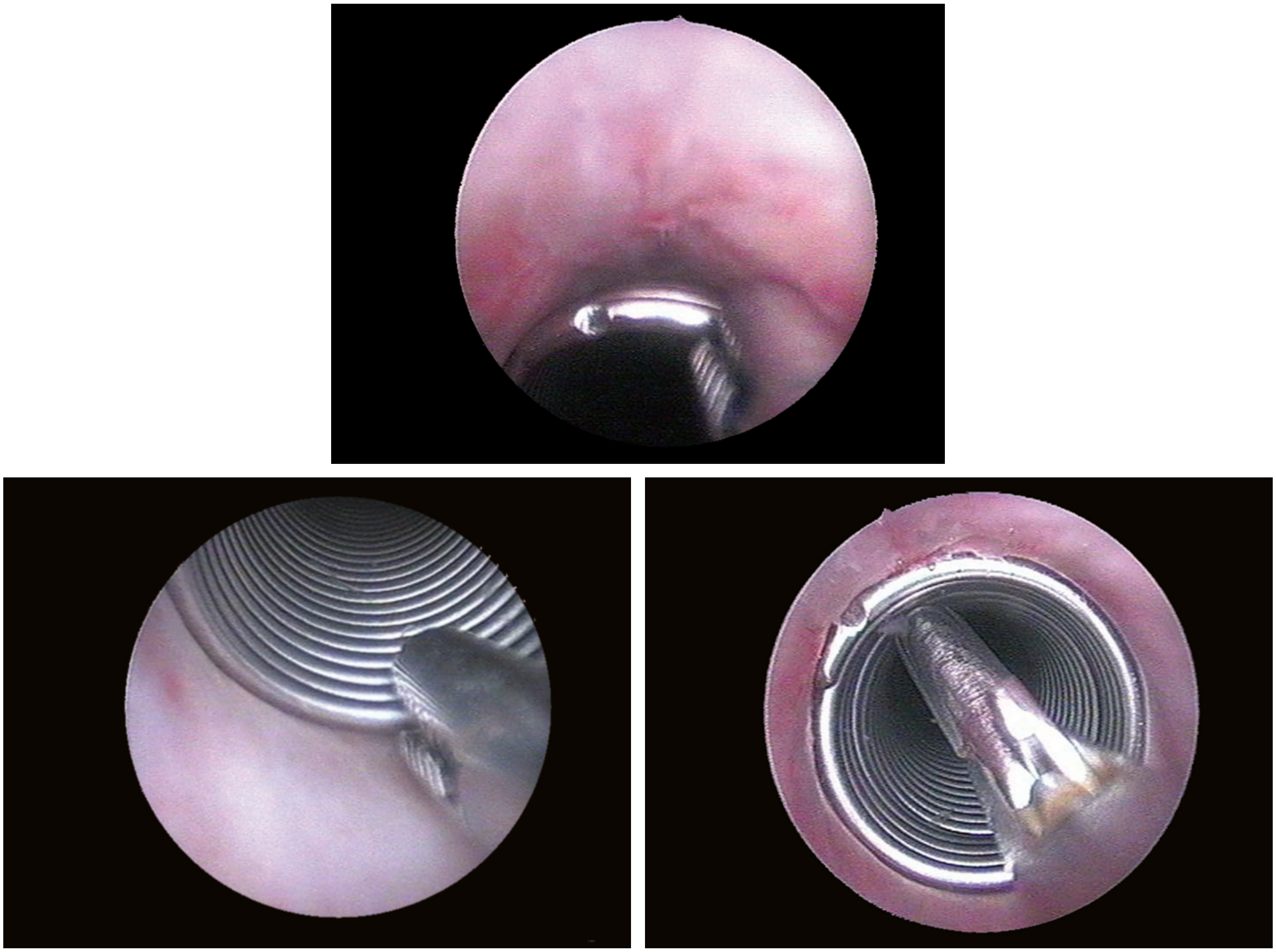

FIGURE 3.13 **Repositioning of a malpositioned stent using tweezers.**

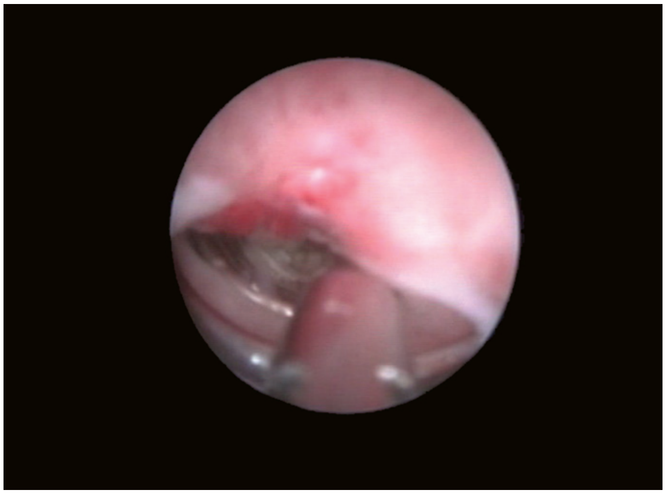

FIGURE 3.14 Tractioning at the distal end of the stent with forceps for extraction after injecting water at 5°C.

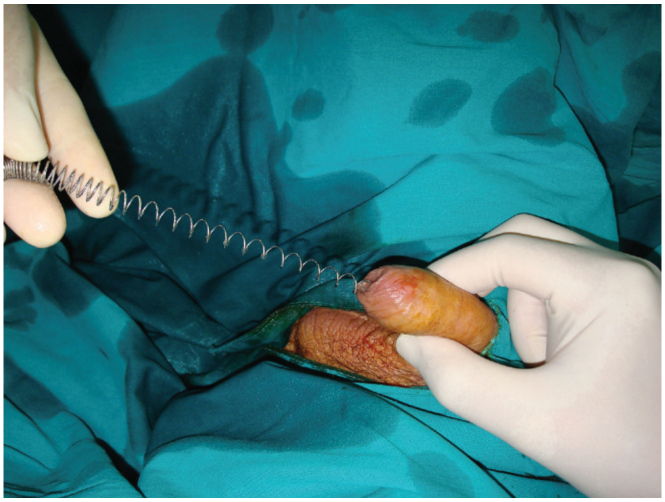

FIGURE 3.15 Extraction of the stent under the form of a metallic wire.

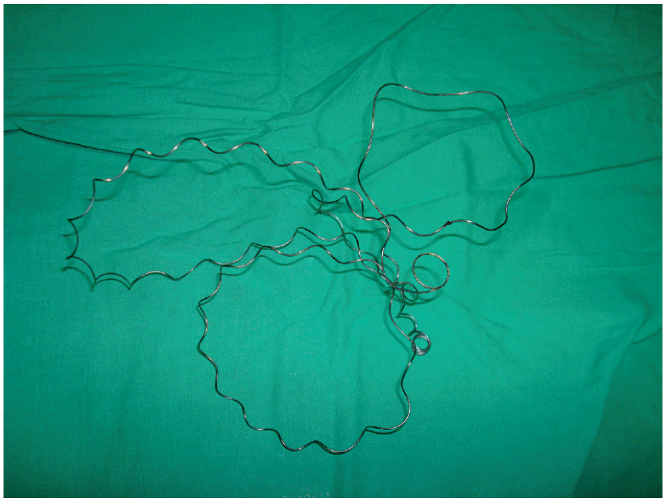

FIGURE 3.16 Memokath metallic stent after extraction from the urethra.

- UroCoil-S® – made of a long segment, which is placed at the level of the stricture, and a short segment, for anchoring at the prostatic urethra level, united by a transsphincterian helicoidal wire; indicated in bulbar strictures
- UroCoil Twin® – made of two long segments, one for the prostatic urethra and one for the bulbomembranous urethra, united by a transsphincterian helicoidal wire; this model is indicated for stenting complex strictures, overlying and underlying the external sphincter.

UroCoil stents are placed with the help of a special applicator. The urethra is prepared by dilation or optical urethrotomy up to a diameter of 20–22F. If a 22F caliber is surpassed, the stent can migrate. If bleeding occurs during endoscopic incisions, a Foley catheter is inserted and the intervention will be postponed for several days in order to avoid obturation of the stent with blood clots (Yachia, 2004).

The length of the stricture is measured by inserting a catheter with radiopaque measurement units, its limits being indicated by applying radiopaque adhesive lines. When, due to the position of the stricture, placement of the stent also involves the external sphincter (UroCoil-S and UroCoil Twin models), its position is identified on the preoperative retrograde urethrography.

The length of the stent is chosen according to the model of the stent used. Thus, in the case of UroCoil stents, 2 cm is added to the measured length so they may reach 1 cm cranial and 1 cm caudal into the healthy urethra. For UroCoil-S stents, 2 cm is added to the distance measured between the external spincter and the distal portion of the stricture. In the case of UroCoil Twin stents, 1 cm is added to the distance between the neck of the bladder and the external sphincter (at the cranial segment), and another 1–2 cm to the distance between the sphincter and the distal end of the stricture (at the caudal segment).

The applicator is placed in the correct position by sliding on a metallic guide, which is endoscopically mounted. When the stent is released from the applicator, it shortens by approximately 40% from the superior end. For this reason, the stent is initially placed 1–2 cm above the cranial marker. In UroCoil-S and Twin models, the portion between the two segments must be positioned at the level of the marker that signals the external sphincter.

After checking the correct position by fluoroscopy, the handle of the applicator is rotated clockwise (1–2 rotations), releasing the cranial end of the stent, which starts to expand. If minor positioning errors exist, these may be corrected during this step by pushing upwards or withdrawing the applicator. If the position is correct, clockwise rotation of the applicator will continue until the whole stent is released.

For the UroCoil-S and Twin models, the correct placement of the transsphincterian wire must be checked, by evaluating continence and the possibility of voluntarily interrupting the urinary jet.

Repositioning of stents over small distances (1–2 cm) is possible even after they have been placed. The UroCoil model is maneuvered by catching one of the ends with tweezers, while for UroCoil-S and Twin models, a smaller caliber cystoscope (17F) is inserted through the stent's lumen and traction is exercised on the transsphincterian wire.

The stent is removed under local anesthesia by catching the first coil with tweezers and gently extracting. This maneuver makes the stent loosen into a metallic wire. The distal ends present two small spheres that serve as safety markers of a complete extraction.

3.5.8 Allium Stent

Alliums are hybrid self-expandable temporary stents (alloy skeleton and polymeric shell) indicated for the recalibration of bulbar strictures located up to 1 cm from the external spincter (Fig. 3.17). The stent is placed under visual or fluoroscopic control, using special applicators that have a 0° optical system (Fig. 3.18).

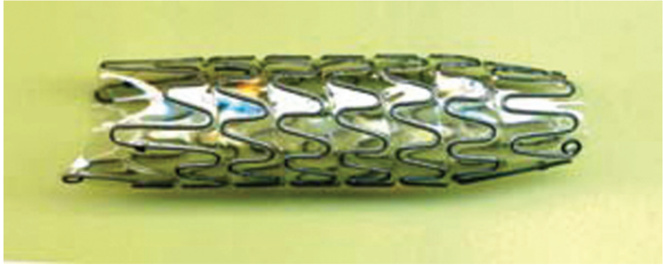

FIGURE 3.17 **Allium stent for recalibration of bulbar urethra strictures (Allium Medical, Caesarea, Israel).**

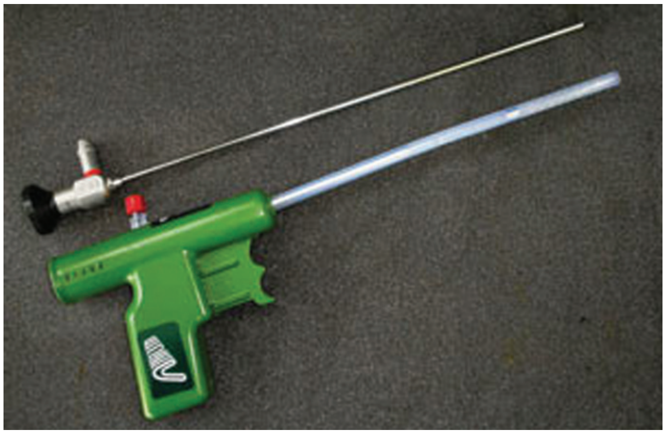

FIGURE 3.18 **Allium stent applicator, with a 0° optical system (Allium Medical, Caesarea, Israel).**

Recalibration of the urethra is performed by dilation or urethrotomy up to 24F, and the stricture's position and length and the distance to the sphincter is measured by fluoroscopy, using marked catheters with a radiopaque scale. The length of the stent is chosen by adding 1 cm to the distance between the extremities of the stricture.

The stent is positioned under visual control and is released using the trigger of the applicator. Once applied, the stent will expand, so that withdrawal of the stent into the mounting device and repositioning become impossible. If the position proves to be incorrect, the stent will have to be extracted and a new one inserted in its place. Expansion of the stent to its maximum caliber may take several days (Yachia and Markovic, 2008). The stent is removed by tractioning with extracting forceps. For an easy extraction, the stent begins to unravel starting from a force of 500–600 g.

3.5.9 Polyurethane Stents (Nissenkorn)

Nissenkorn stents are polyurethane stents that have an autostatic basket, with a shape similar to that of the distal portion of a Malecot catheter. The first step of the intervention is represented by recalibration of the urethra by optical urethrotomy. Subsequently, the urethrotome is positioned proximally from the incized area. After extracting the telescope, the stent is inserted through the sheath of the endoscope, taken out of the cartridge in which it is packed. Using a pusher (the "blind" mandrel of the urethrome may be used), the prosthesis is pushed upward to the urethral level. After reassembling the endoscope under visual control, the stent is pulled distally with the help of the attached 4/0 wire. After the correct position is checked (the autostatic basket proximal from the stricture and the straight area of the stent at the incision level), the wire is cut and removed (Nissenkorn, 1995).

3.5.10 Polyglycolic Acid Stents

These are 21.5F diameter stents that become self-expandable at body temperature, in about 11 min, up to 33F. In order to preserve this property, they must be kept before the intervention at a temperature of −18°C (Isotalo et al., 2002).

After measuring the length of the stricture, the adequate stents are chosen. These prostheses have an initial length of 3.5 or 5 cm, but they can be cut according to the requirements of the case.

They are endoscopically placed, and the distal position is adjusted with the help of a wire attached to the stent's coils. After the expansion period, the proximal extremity is inspected with the help of a pediatric cystoscope or a urethroscope, especially in case of strictures in the vicinity of the external sphincter. A suprapubic catheter is placed at the end of the intervention, which is suppressed when the patient starts to urinate adequately.

Complete epithelialization of the stents occurs in the first 6 months, and degradation and complete resorption in 12 months.

Oosterlinck proposed placing a patch of preputial tissue on a resorbable stent in 3 weeks, thus performing a hybrid intervention between endoscopic urethroplasty and temporary stenting (Oosterlinck and Talja, 2000).

3.6 COMPLICATIONS

Urethral and prostatic stents are associated with a specific morbidity, this being one of the arguments which has contributed to limitation of their indications. Potential complications are influenced by a complex of factors that include the type of stent, the disease for which stenting was performed, the mode of selecting patients, etc.

3.6.1 Permanent Urethral Stents

Permanent stents such as UroLume theoretically present a lower risk of urinary infections, migration, or incrusting.

3.6.1.1 Faulty Positioning

This represents an intraoperative incident, which may be due to the incorrect choice of a stent's length, to its position, to the shortening phenomenon of the prosthesis during expansion, or to its migration. If the incorrect positioning is noticed before releasing the second safety of the applicator, it may be corrected in the way described in the section dedicated to technique. If the incident is identified after complete expansion of the stent or even after the intervention (generating so-called "false recurrences") it is necessary to remove the stent and to place a new one. Some authors have reported serial placement of a second stent after identifying an area of stenosis surpassing one of the extremities of the first one (Milroy and Allen, 1996; García Peñalver et al., 2007).

3.6.1.2 *Dysuria*

Dysuria has been reported by some authors to be the most frequent complication in patients with urethral stents, its incidence reaching 32–51%, at least in the first 2 years (Hussain et al., 2004; Shah and Badlani, 2004).

3.6.1.3 *Stenosis Due to Intraluminal Tissue Growth*

The epithelialization phenomenon, characteristic for this type of endoprostheses, may lead to restenosis of the lumen, a late complication that may require extraction of the stent.

Tissue growth inside the prosthesis takes place between the metallic wires. Despite the relatively high incidence of intraluminal tissular development, in most cases it is clinically insignificant.

Transurethral resection has been proposed for solving this complication, and is applicable in approximately 60% of these cases (Milroy and Allen, 1996; Keppenne et al., 1997). The risk factors for restenosis due to intraluminal tissue growth are controversial.

For UroLume stents, the rate of this complication ranges from 0% to 52% (Sneller and Bosch, 1992; Baert et al., 1993; Milroy and Allen, 1996). Ricciotti et al. (1995) report a rate of intraluminal tissue growth of 10.5% with the use of Memoterm type stents. Extraction of the stent due to this complication becomes necessary in approximately 3–5% of these patients (Badlani et al., 1995; Shah et al., 2003b).

3.6.1.4 *Urinary Infections*

According to data in the literature, the incidence of urinary infections varies between 4.2% and 27% of cases (Ashken et al., 1991; Hussain et al., 2004; Shah and Badlani, 2004). However, according to the North American UroLume Trial, the incidence of urinary infections does not differ significantly from the data recorded before the intervention. The existence of positive urocultures before stenting is considered to be the only positive predictive factor for this complication (Shah and Badlani, 2004).

3.6.1.5 *Urinary Incontinence*

Urinary incontinence may be a consequence of a faulty placement of the stent at the level of the external sphincter or of involvement of this structure by the inflammatory processes initiated by the presence of the foreign body.

In the North American UroLume Trial, severe urinary incontinence was recorded in 4.3% of cases after 6 weeks, its incidence decreasing to 2.5% after 2 years. Medium intensity urinary incontinence occurred in 20% of cases after 2 years. Unfortunately, because this parameter was not recorded preoperatively, it is difficult to evaluate if it already existed before stenting (Shah and Badlani, 2004). Another multicentric trial performed by the Sicilia–Calabria Society of Urology reported a rate of urinary incontinence of 14% (Morgia et al., 1999).

3.6.1.6 *Stent Migration*

Stent migration is a rare complication in patients with permanent devices, occurring in approximately 2.5% of cases. This complication may occur only in the initial period, before the stent is embedded into the urethral wall.

3.6.1.7 *Irritative Symptomatology*

Irritative symptoms such as pollakiuria or imperious mictions may occur in a significant percentage of cases in the first 12 months, but usually improve spontaneously or under anticholinergic treatment (Milroy and Chapple, 1993; Guazzoni et al., 1993; Oesterling et al., 1994; Anjum et al., 1997).

3.6.1.8 *Other Complications*

Other complications associated with this type of stent are represented by hematuria (6–14%), perineal pain (2–13%), retrograde ejaculation (0–17%), or painful erections (0–44%) (Milroy and Chapple, 1993; Guazzoni et al., 1993; Oesterling et al., 1994; Anjum et al., 1997; Morgia et al., 1999).

A case of poorly differentiated urothelial carcinoma has also been reported, attributed by the authors to chronic irritation secondary to the presence of a UroLume type permanent stent (Paddack et al., 2009).

3.6.2 Temporary Urethral Stents

Regarding temporary stents, the rate of complications varies in the literature between 13.5% and 18% (Knutson et al., 2002; Perry et al., 2002). Among the complications frequenly reported, the following are worth mentioning: recurrent urinary infections, incrusting and fracture of the stents, irritative symptoms, and urine retention (Konety et al., 2000; Henderson et al., 2002).

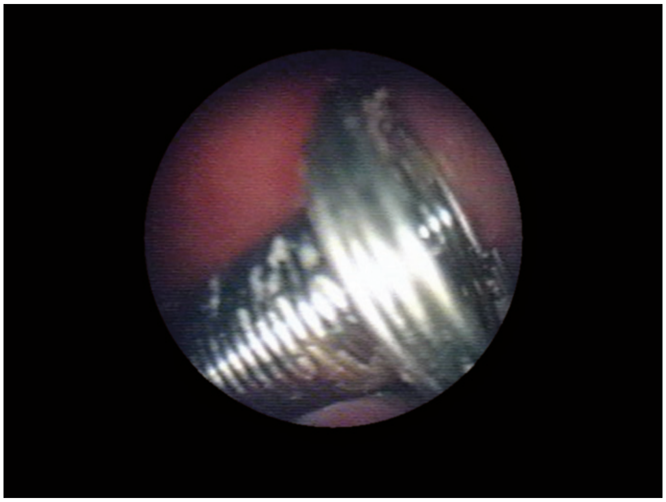

FIGURE 3.19 Urethral stent migrated into the urinary bladder.

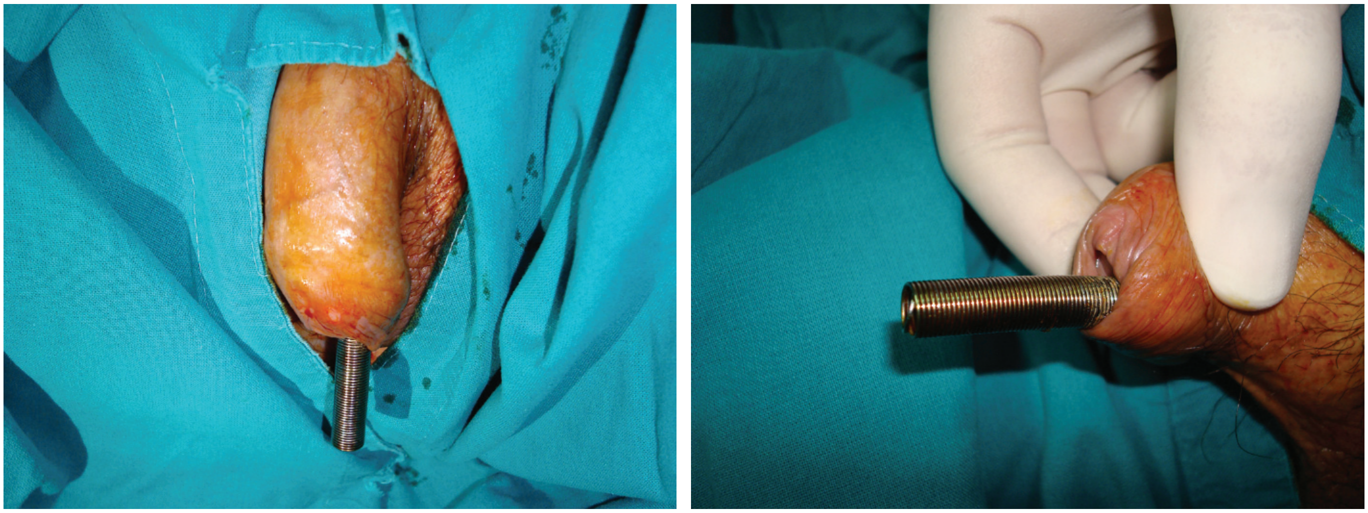

FIGURE 3.20 Memokath urethral stent with descending migration.

These complications may require stent removal, with a direct impact on the success rate of the intervention. The failure rate due to complications may reach 20–30% of cases (Ogiste et al., 2003).

3.6.2.1 *Stent Migration*

One of the complications with a direct and significant impact on the efficacy of the method in the durable solution of the urethral obstacle is represented by ascending or descending migration of the stent (Figs 3.19 and 3.20). This has been reported in 9–40% of cases (Sikafi, 1996; Perry et al., 2002; Choi et al., 2007; Nita et al., 2010).

Thus, in a study on 211 patients with a follow-up of 8 years, Perry reports a stent migration rate of 13% (Perry et al., 2002). In other studies, the stent migration rates may reach 33.8%, representing the main cause for their extraction (Choi et al., 2007).

Stents with ascending migration into the urinary bladder are usually subject to incrusting and calcification processes on their external face (Fig. 3.21), phenomena that make their extraction more difficult (Fig. 3.22).

For polyurethane stents with autostatic basket, Nissenkorn reported a migration rate of 9.1% (Nissenkorn, 1995).

3.6.2.2 *Stent Incrusting*

The fact that the intraluminal surface of temporary stents does not present the phenomenon of epithelialization creates the inconvenience of its potential calcification (Fig. 3.23). The incidence reported for this complication is of 20%, and may require extraction of the prosthesis (Hamid et al., 2003) (Figs 3.24 and 3.25). Second generation stents such as Memokath seem to associate a lower incrusting rate of only 10% (Staios et al., 2007).

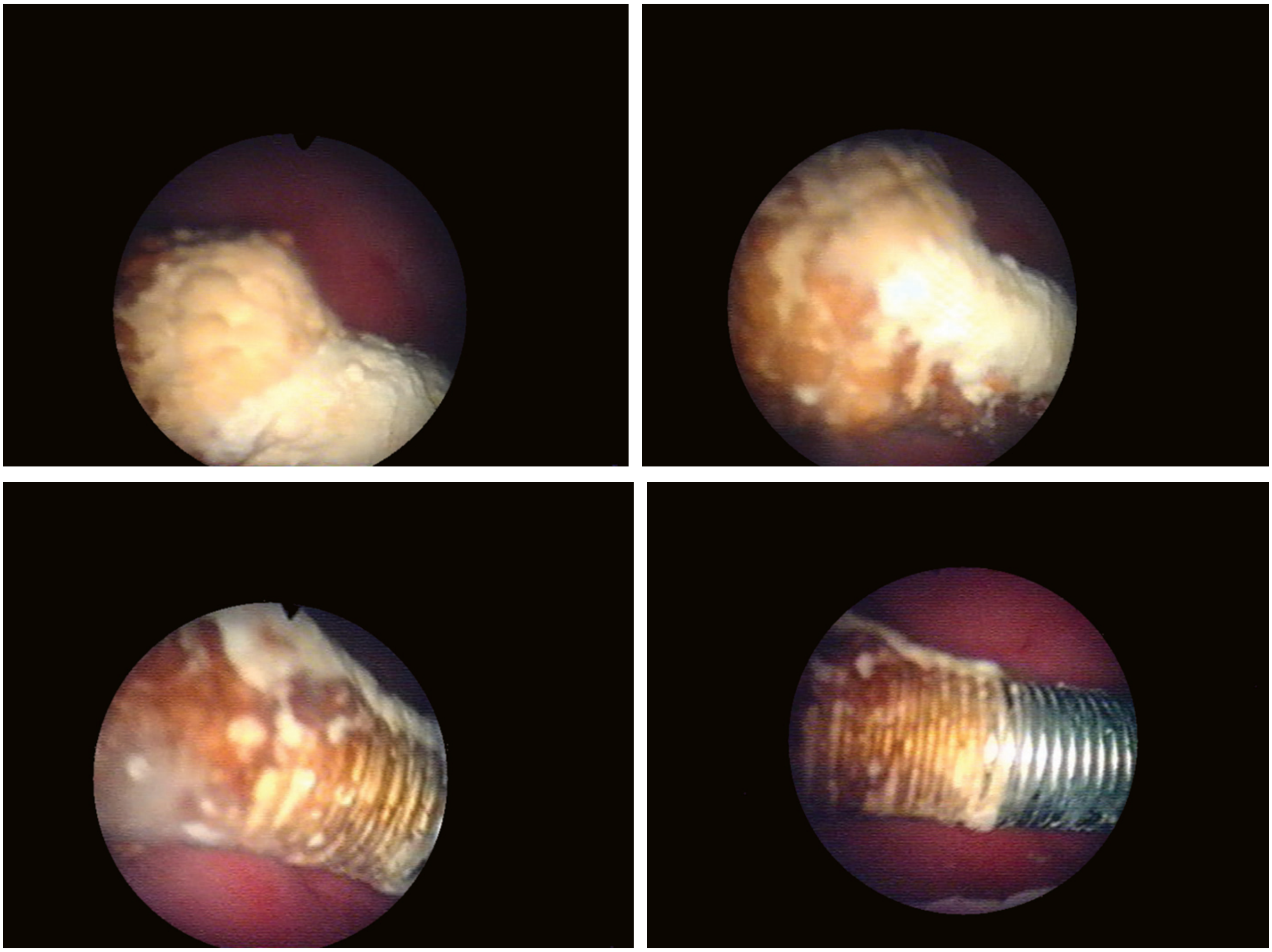

FIGURE 3.21 Memokath temporary stents migrated into the urinary bladder and calcified.

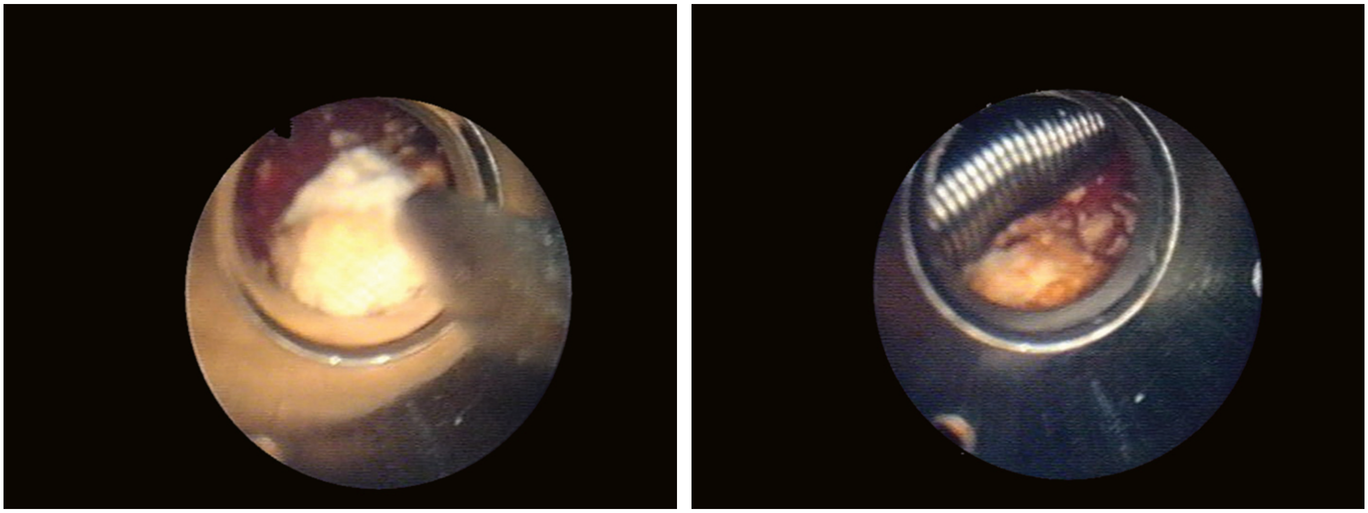

FIGURE 3.22 Ballistic lithotripsy of calcifications on the external surface of a stent for its extraction.

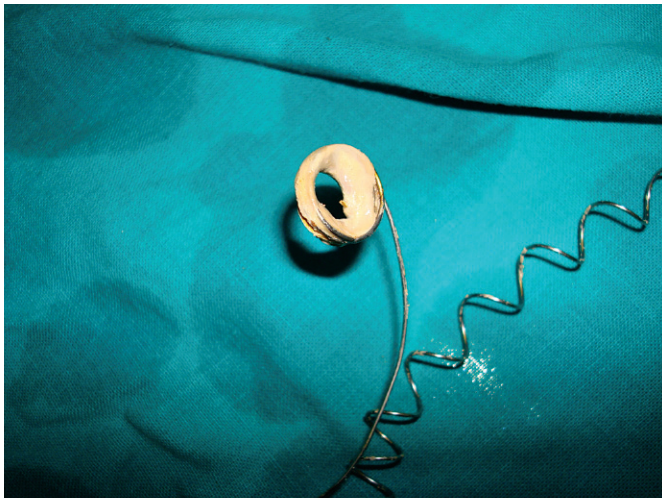

FIGURE 3.23 **Calcification on the cranial portion of a Memokath stent extracted from the urethra.**

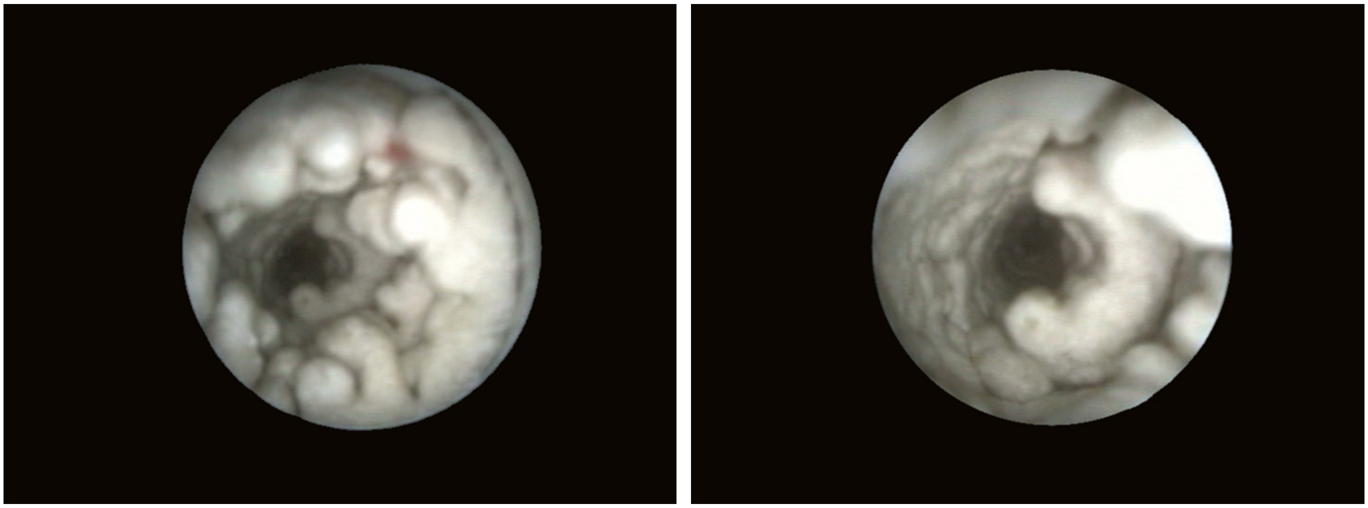

FIGURE 3.24 **Stent calcified on the intraluminal surface.**

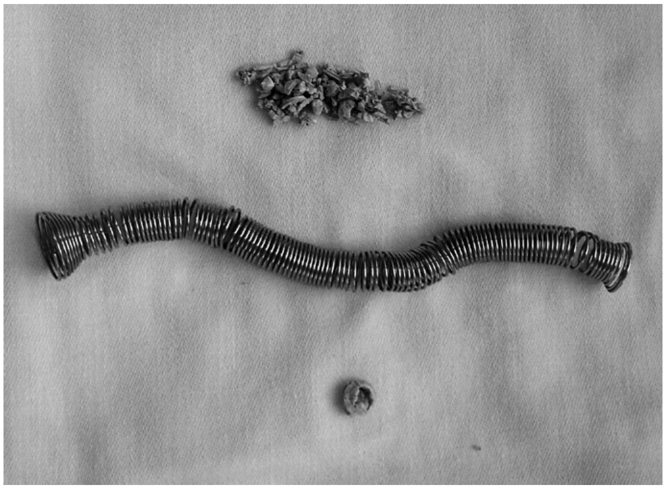

FIGURE 3.25 **Aspect after extraction of an incrusted Memokath stent and of lithiasic fragments initially located in the lumen.**

3.6.2.3 *Stenosis Due to Intraluminal Tissue Growth*

Stenosis due to intraluminal tissue growth rarely occurs in the case of temporary stents, due to their shape and to the small distance between coils (Saporta et al., 1993) (Fig. 3.26). Even in patients in whom this complication occurs, it is usually in a small quantity (Fig. 3.27).

3.6.2.4 *Other Complications*

Other complications may be represented by hematuria, urinary retention, and incontinence (Perry et al., 2002).

A special mention must be made regarding polyglycolic acid stents. Collapse of the coils occurs in some stents at the moment of bioabsorbtion, and the resulting fragments may perforate the urethral wall and generate lesions that, in the end, lead to luminal obstruction (Yachia and Markovic, 2008).

3.7 RESULTS

3.7.1 Permanent Urethral Stents

The results published in the literature also present a high variability regarding the efficacy of stent placement for urethral strictures (Table 3.3).

The short-term success rate (18 months) of the intervention varies between 70% and 100%, but in the long term this success rate decreases to only 7.7–66.7% (Abbar et al., 1993; Baert et al., 1993; Keppenne et al., 1997; De Vocht et al., 2003; Hussain et al., 2004; Shah et al., 2003b).

The great variability of the results is explained by the heterogenous series included in the studies. These differ through type of stent used, etiology of strictures, characteristics of strictures, follow-up period, definition of success (clinic, anatomic, radiologic), etc.

Milroy and coworkers report a success rate of 63% after placement of UroLume type permanent stents in patients with bulbomembranous urethral strictures. They divide cases that presented recurrences into real failures (with narrowing of the stent lumen) and false failures, in which the strictures occurred at one of the ends of the stent, a situation which in reality is generated by a faulty positioning of the prosthesis. In the literature, the rate of false failures varies between 9% and 18%, while that of real failures is between 5% and 16% (Breda et al., 1994; Milroy and Allen, 1996). For the first category, the authors recommend inserting a second overlapping stent, which will also cover the unprotected portion of the stricture. Management is more complex in the case of real failures, ranging from endoscopic resection to excision of the stent together with the urethral wall, followed by reconstructive surgery (Milroy and Allen, 1996).

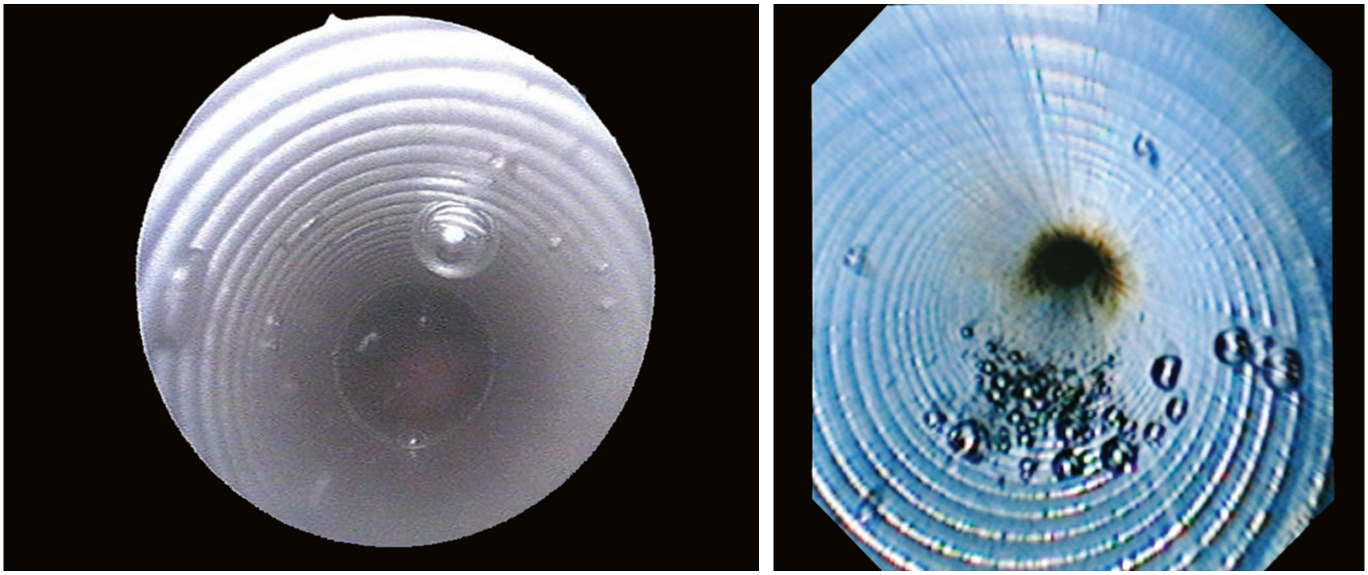

FIGURE 3.26 Aspect of the intraluminal surface of a Memokath metallic stent.

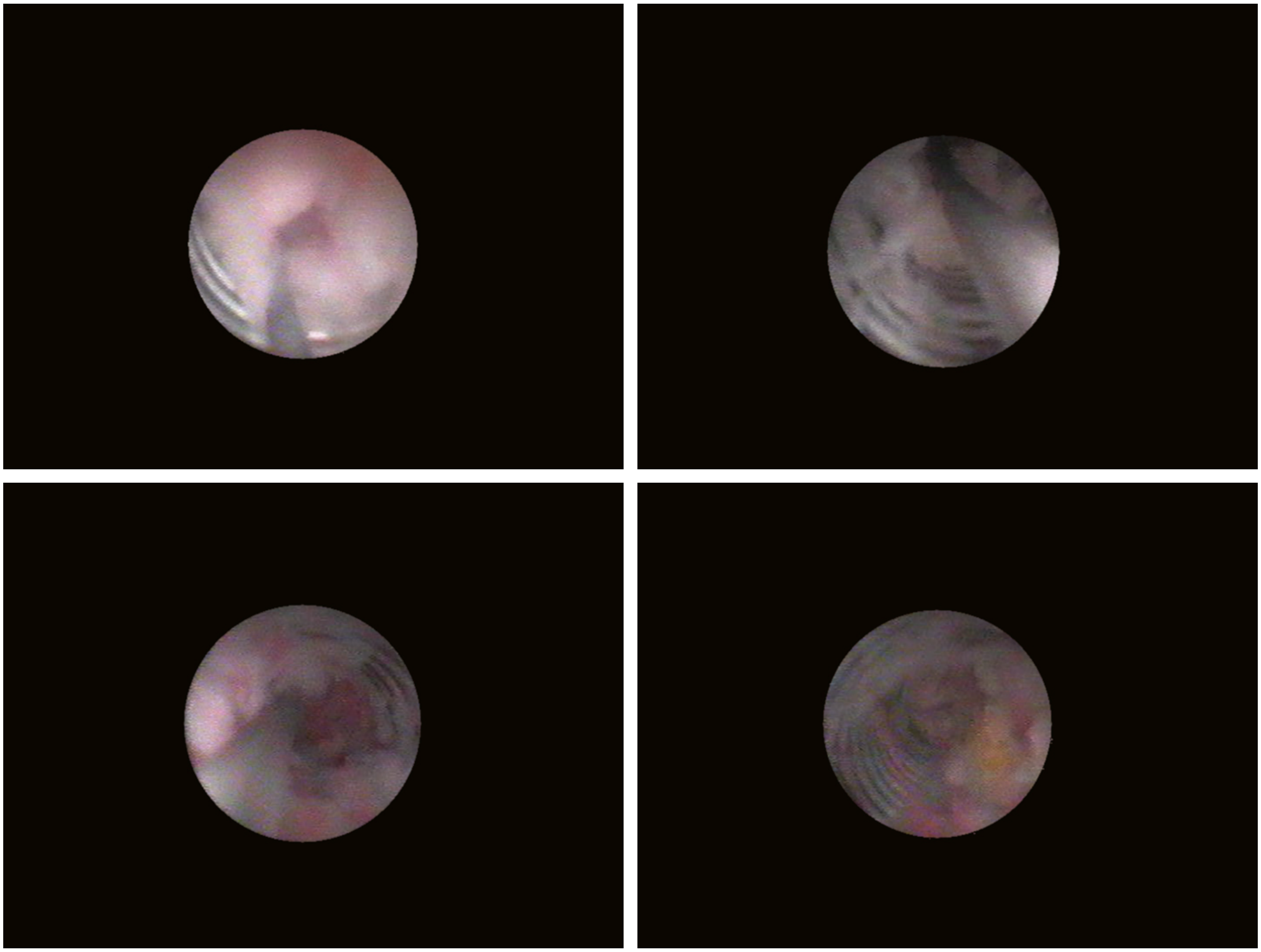

FIGURE 3.27 **Different aspects of intraluminal tissue growth in temporary metallic stents.**

In patients with UroLume stents who required reinterventions, Hussain et al. (2004) performed intraluminal tissue resection in 35% of cases, urethrotomy or urethral dilations in 25% of cases and litholapaxy of calcifications in 17% of cases.

In isolated cases, placement of a second UroLume stent inside the first one, after progressive dilations, has been reported (Pansadoro et al., 1994). Shental et al. (1998) indicate placement of a Urethrospiral type temporary stent inside the stenosed lumen of a UroLume prosthesis. Different factors have been incriminated in the appearance of restenosis of the lumen of permanent stents.

A positive predictive factor for the appearance of this complication is considered to be the traumatic etiology of the strictures (Sneller and Bosch, 1992; Verhamme et al., 1993). However, contrary to this opinion, the multicentric North American UroLume Trial indicates previous urethroplasties as the main predictor for stenosis of the stent's lumen (Shah and Badlani, 2004).

Milroy and Allen (1996) identified among the risk factors for occurrence of this complication, posttraumatic or posturethroplasty etiology, duration of the stricture's evolution, and severity of the spongiofibrosis process. A well-vascularized spongious corpum is necessary for epithelialization of the stent. In all the above-mentioned categories, patients present abundant fibrous tissue at this level, with a low blood supply, explaining the unfavorable evolution, with restenoses (Chapple and Bhargava, 2008).

In a North American multicentric trial regarding endoprosthesis for urethral strictures in a group of 179 patients (however, of which only 24 were available for the 11-year long-term follow-up), Shah et al. (2003a) reported a success rate of 66.7%.

TABLE 3.3 Results of Stenting with Permanent Devices

Authors	No. of patients	Success rate (%)	Failure rate (%)	Explant rate (%)	Follow-up
Garcia Penalver (2007)	7	85.7	14.3	0	–
Hussain et al. (2004)	60	55	45	0	12 years
Serrano-Brambila et al. (2003)	10	90	10	10	12 months
De Vocht et al. (2003)	13	69.2 7.7	30.8 92.3	23.1 –	60 months 120 months
Shah et al. (2003b)	24	66.7	33.3	5	11 years
Sertcelik (2000)	60	87	13	–	45.6 months
Keppenne et al. (1997)	33	78.8	21.2	–	24 months
Guzman Martinez-Valls (1996)	17	88.9	11.1	–	11–40 months
Milroy and Allen (1996)	50	63	36	6	48 months
Badlani et al. (1995)	81	85.7	14.3	3	12 months
Breda et al. (1994)	76	86	14	–	1–40 months
Abbar et al. (1993)	14	85	15	15	17.5 months
Baert et al. (1993)	7	42.9	57.1	14.3	23–31 months
Lymberopoulos et al. (1992)	23	100	0	0	16.8 months
Sneller and Bosch (1992)	5	60	20	–	–
Donald (1991)	33	57.6	42.4	–	6–12 months
Sarramon (1990)	18	100	0	0	
Milroy et al. (1989)	12	100	0	0	7 months

Regarding placement of multiple permanent stents, Tillem and coworkers perform this procedure in 23% of cases. The indications for placement of multiple prostheses during the initial intervention were represented by multiple strictures or single strictures, longer than 2.5 cm. Secondary insertions were performed in patients with strictures in the vicinity of the stent (faulty positioning), intraluminal tissue growth or spaces between adjacent stents. For this subpopulation, the rate of repeated therapies was of 43.9% compared with 14.3% in the whole group (Tillem et al., 1997).

3.7.2 Temporary Urethral Stents

For temporary stents, short- and medium-term results are encouraging (Geavlete et al., 2008), but their long-term efficacy is controversial (Table 3.4). The principle of applying these stents (creating a matrix for a period of time, ensuring a wide lumen that will remain stable after suppressing the prosthesis) is one of the reasons for the heterogeneous reporting of long-term results. Some series present patients in whom stents were suppressed (Fig. 3.28)

TABLE 3.4 Results of Stenting with Temporary Devices

Authors	No. of patients	Success rate (%)	Management of failures	Stent type	Follow-up (months)
Saporta et al. (1993)	16	100	–	Nithinol	3–9
Yachia (1991)	18	94.4	Restenting	Nithinol	5
Song (2003)	12	100	Restenting	Nithinol	20
Nissenkorn (1995)	22	72.7	Restenting	Polyurethane	11.2
Isotalo et al. (2002)	22	36	Urethrotomy, urethroplasty	Bioabsorbable	48
Geavlete et al. (2008)	8	87.5	Restenting	Nithinol	14

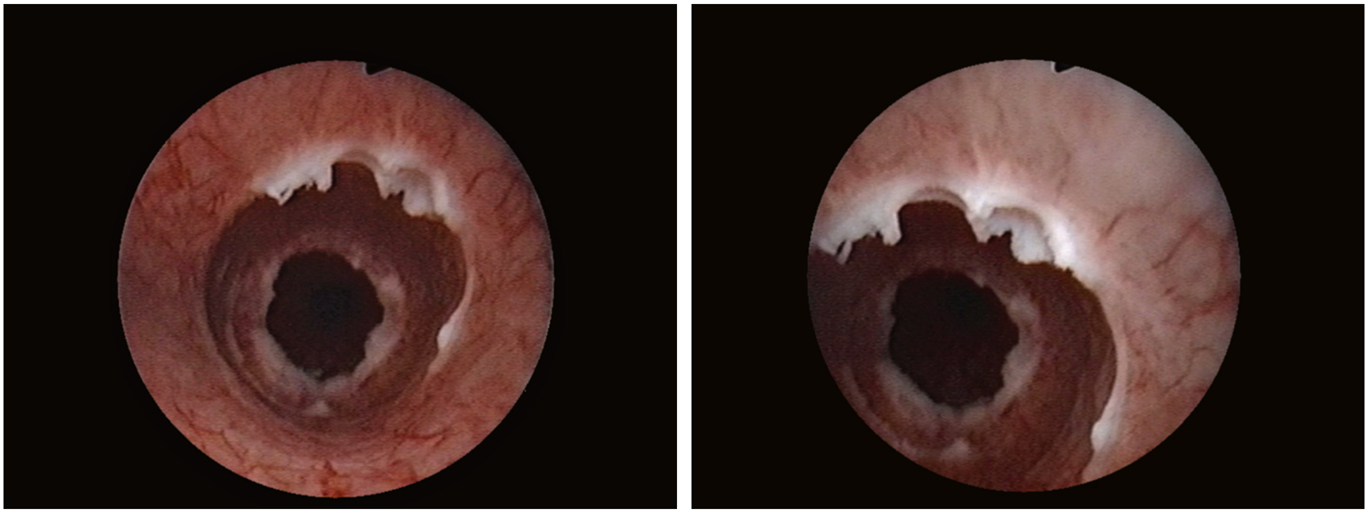

FIGURE 3.28 **Wide aspect of the urethra after suppressing a temporary urethral stent.**

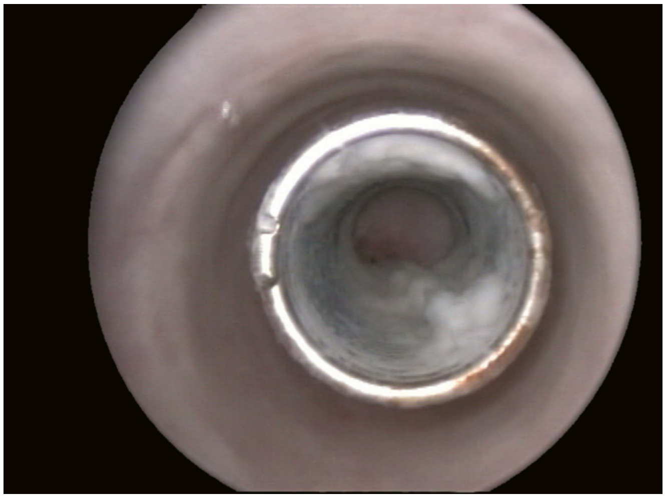

FIGURE 3.29 **Intraluminal calcification and recurrent stenosis immediately overlying a Memokath temporary stent.**

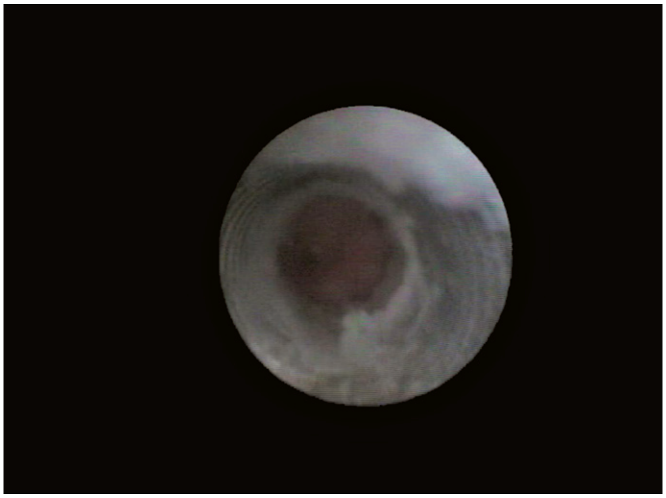

FIGURE 3.30 **Intraluminal calcifications of a temporary stent.**

together with those in whom they are still present and still susceptible to complications such as obstructive calcification (Figs 3.29 and 3.30), thus generating confusion.

Thus, Yachia and Beyar report a patent urethral lumen in 17 of the 18 patients stented with a temporary metallic prosthesis. However, some observations are necessary: stents were suppressed in only six of these patients, with a medium follow-up of 5 months. The failure rate after stenting (Fig. 3.31) is actually 16.7%, in which case a new prosthesis is required (Yachia and Beyar, 1991) (Fig. 3.32).

The type of stent introduces a new variable in reporting results. Thus, Nissenkorn achieves an efficacy of 72.7% with his polyurethane stent, which requires periodical replacement. In 27.3% of cases, a faulty positioning led to its extraction and insertion of a new one (Nissenkorn, 1995).

Isotalo presents a long-term experience (48 months) with bioabsorbable stents, reporting a success rate of 36%. Most failures were due to collapse of the stents toward the end of the absorbtion period, probably because of external compression, with formation of obstructive intraparietal fragments. However, the failure rate is lower than classical therapeutical methods, and the absence of metallic foreign bodies in the urethral wall does not limit subsequent therapeutical alternatives (Isotalo et al., 2002).

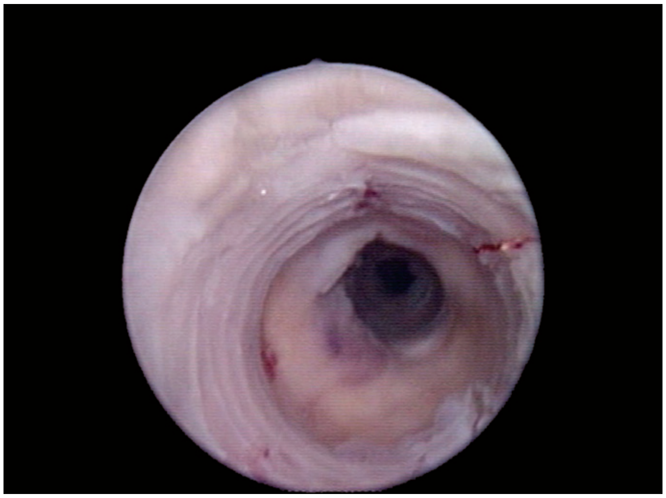

FIGURE 3.31 **Recurrent stenosis immediately overlying the area where the temporary stent was placed.**

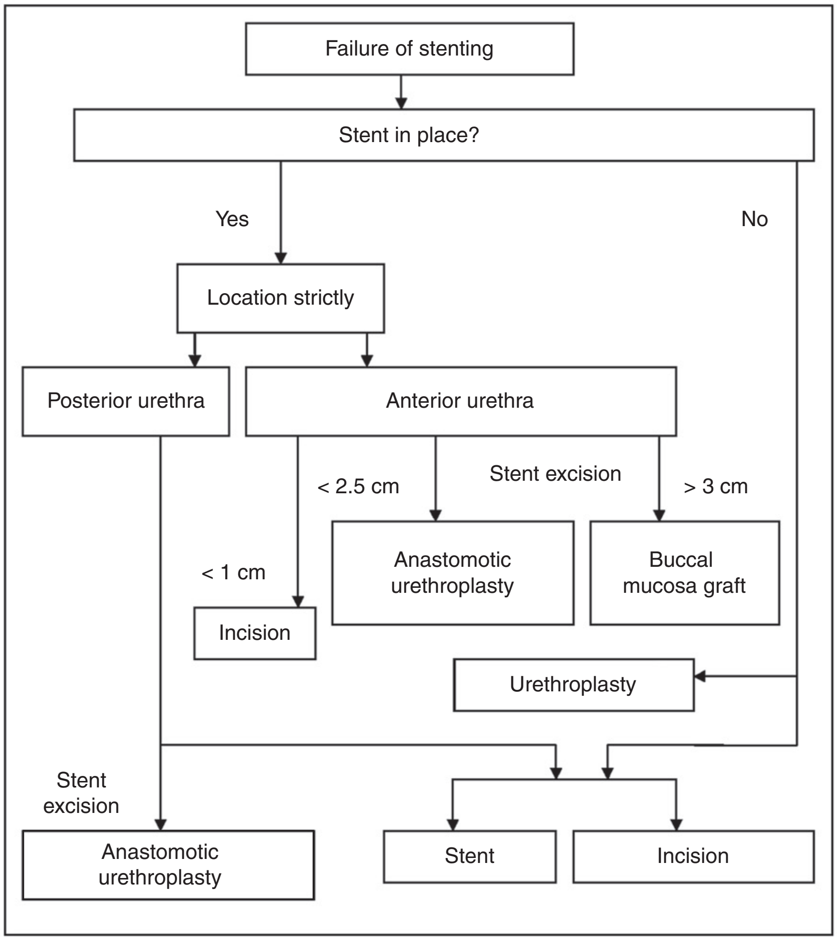
Failure of stenting
Stent in place?
Yes
No
Location strictly
Posterior urethra
Anterior urethra
< 2.5 cm
Stent excision
> 3 cm
< 1 cm
Anastomotic urethroplasty
Buccal mucosa graft
Incision
Urethroplasty
Stent excision
Anastomotic urethroplasty
Stent
Incision

FIGURE 3.32 **Treatment algorithm in patients with restenoses after stenting.** *Adapted from Eisenberg et al. (2008).*

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C H A P T E R

4

Urethral Dilations in Males

Răzvan Mulţescu, Mihai Drăguţescu, Dragoş Georgescu, Bogdan Geavlete

4.1 GENERALITIES

Urethral dilations represent the oldest method for treating urethral strictures. The procedure implies recalibration of the urethral lumen, ideally maintaining integrity of the mucosa and, implicitly, reducing the risk of scar tissue formation. Although the method is very cheap and rapid, it presents the disadvantage of very high recurrence rates, but also of inducing urethral lesions (from urethral abrasions to false passages). Moreover, the method keeps the patient dependent on the urologist, with a significant impact on quality of life.

There are two categories of urethral dilations (Levine and Engebrecht, 1997):

- as a primary procedure, for treating urethral strictures
- as a consolidation method and for preventing recurrence after optical internal urethrotomies or urethroplasties

4.2 INSTRUMENTS

A complex arsenal may be used in urethral dilations:

- catheters and bougies made of plastic material/silicone – especially for penile strictures
- dilators or metallic bougies – especially for bulbar or membranous urethral strictures
- balloon catheters – regardless of the position of the stricture
- hydraulic self-dilation – by initiating urination in case of occlusion of the urethral meatus and of the navicular fossa by manually applying pressure on the gland

Some instruments are dedicated to this purpose (bougies, metallic dilators, balloon catheters, etc.) (Figs 4.1–4.3), while others, usually used in other types of endoscopic interventions, are adapted for use on the urethra (urethral access sheaths, etc.).

4.3 INDICATIONS

The modest success rate in the context of development of much more efficient techniques has led to a significant limitation of the indications for urethral dilations. A relative indication of balloon dilation that still exists is represented by strictures located in the immediate vicinity of the striated sphincter, cases in which urethrotomy presents a high risk of sectioning, and consecutive urinary incontinence (Geist and Hartung, 2006).

Some authors also mention balloon dilation as one of the therapeutic methods for simple urethral strictures and for postprostatectomy stenosis of the vesico-urethral anastomosis; however, they are considered to be too expensive from a cost-efficiency point of view (Ramchandani et al., 1994; Geist and Hartung, 2006).

The main applications are currently represented by prevention of stricture recurrence after optical internal urethrotomy or urethroplasty, especially in patients with important comorbidities, in order to avoid further surgical intervention (Naudé and Heyns, 2005; Sperling et al., 2006).

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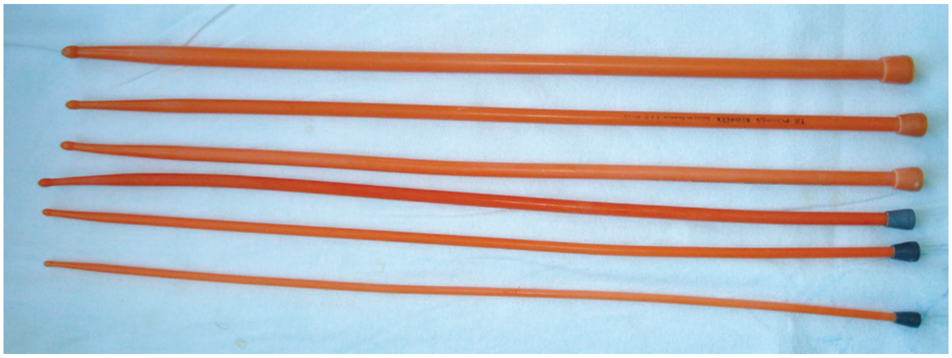

FIGURE 4.1 **Different caliber bougies for urethral dilation.**

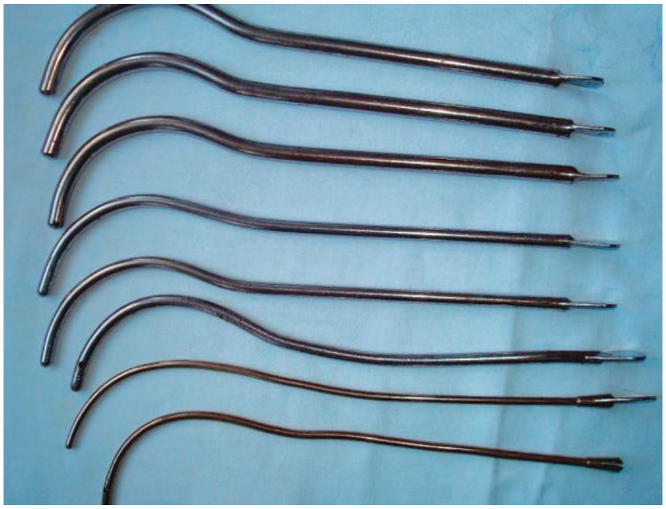

FIGURE 4.2 **Benique type curved metallic dilators of different calibers.**

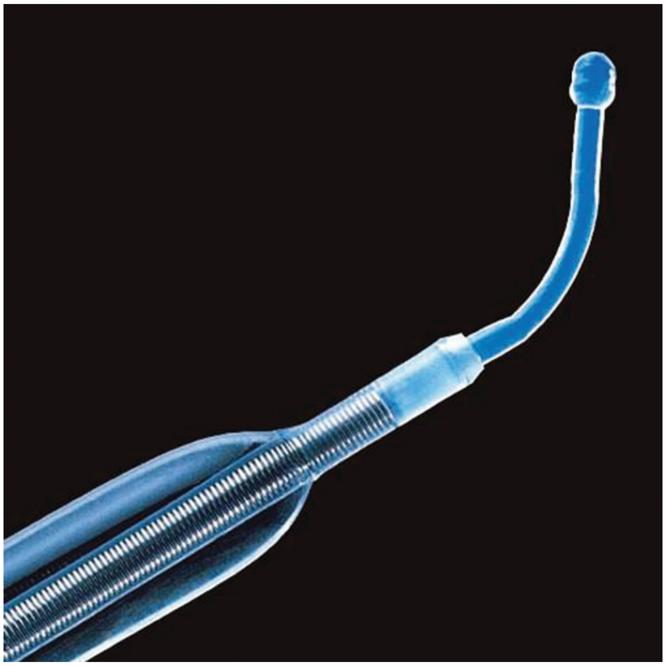

FIGURE 4.3 **Catheter with balloon for urethral dilation (Cook).**

4.4 DILATION TECHNIQUES

4.4.1 Penile Urethra Dilation with Bougies or Catheters

This type of dilation is performed under local anesthesia, by instilling a lidocaine gel on the urethra. Well lubricated bougies or catheters made of plastic masses or silicone with progressive diameters are inserted until the stricture is passed (Fig. 4.4). Their insertion and extraction are performed carefully, avoiding excessive pressure, to avoid tearing of the mucosa or of the urethral wall (Figs 4.5 and 4.6), with consecutive bleeding and the potential formation of scar tissue.

Dilation is interrupted when the diameter of the bougies reaches 24F. Sometimes, in case of tight strictures, successive sessions of dilation are necessary. Once the dilator is in position, it is maintained over a period of time ranging from 5 min to 20 min.

4.4.2 Bulbar and Membranous Urethra Dilation with Metallic Dilators

Benique type curved metallic dilators are used for this purpose. After local anesthesia, well lubricated dilators are inserted into the urethra until their distal portion reaches the bladder neck.

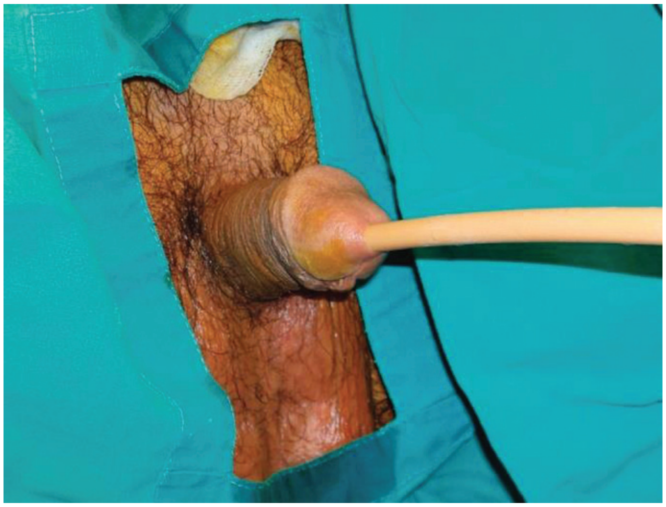

FIGURE 4.4 **Dilation of the urethral meatus and of the penile urethra with bougies.**

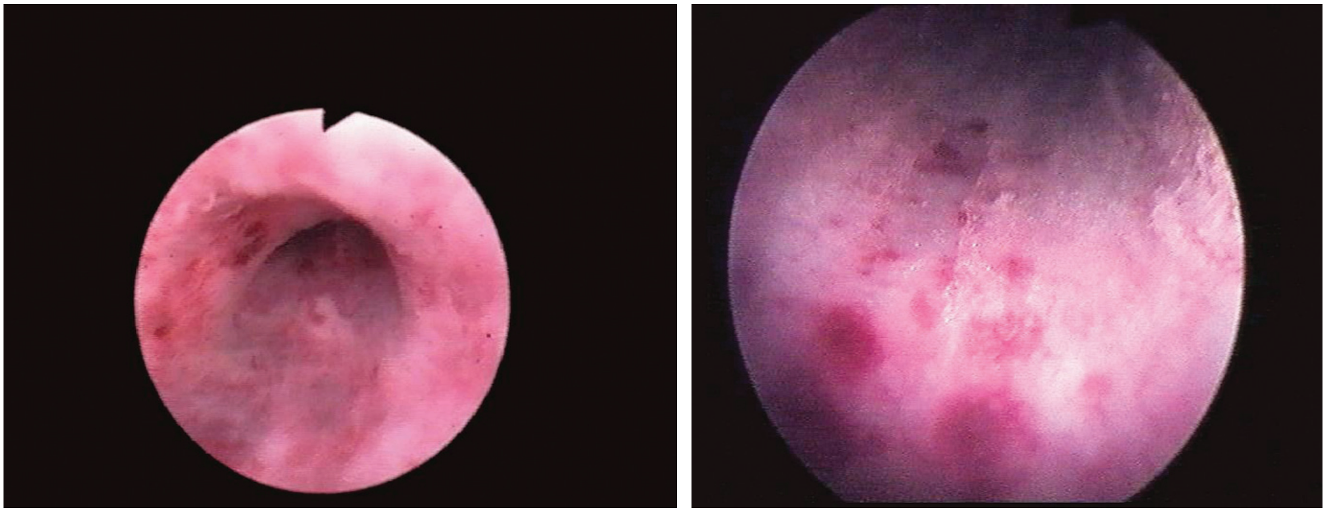

FIGURE 4.5 **Lesions of the urethral mucosa consecutive to dilation with bougies.**

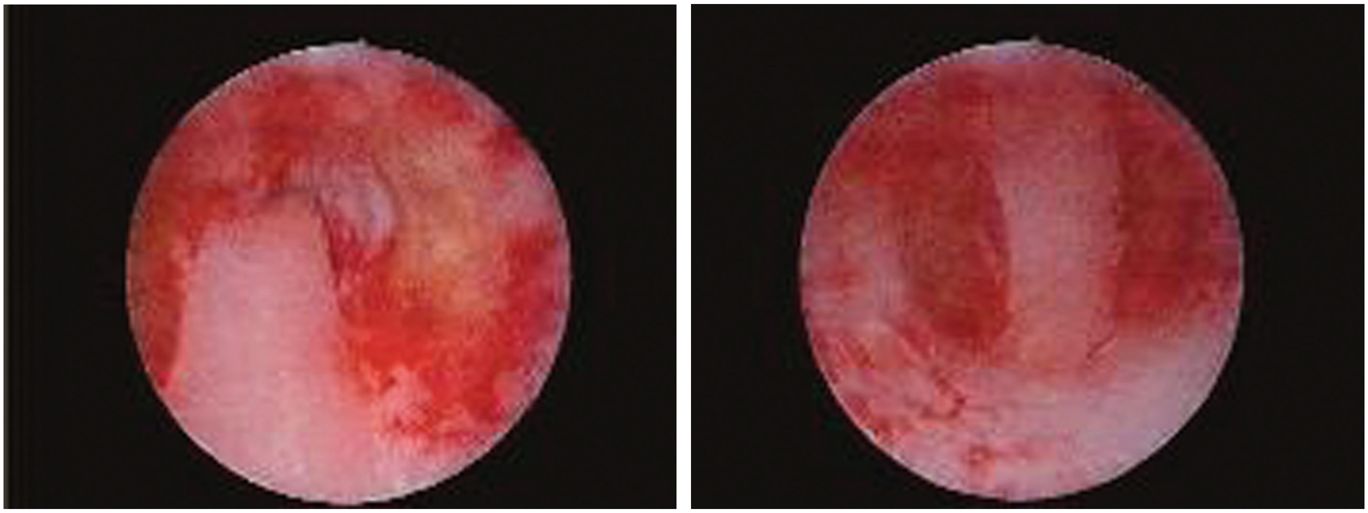

FIGURE 4.6 **Flap of detached mucosa after a "blind" dilation.**

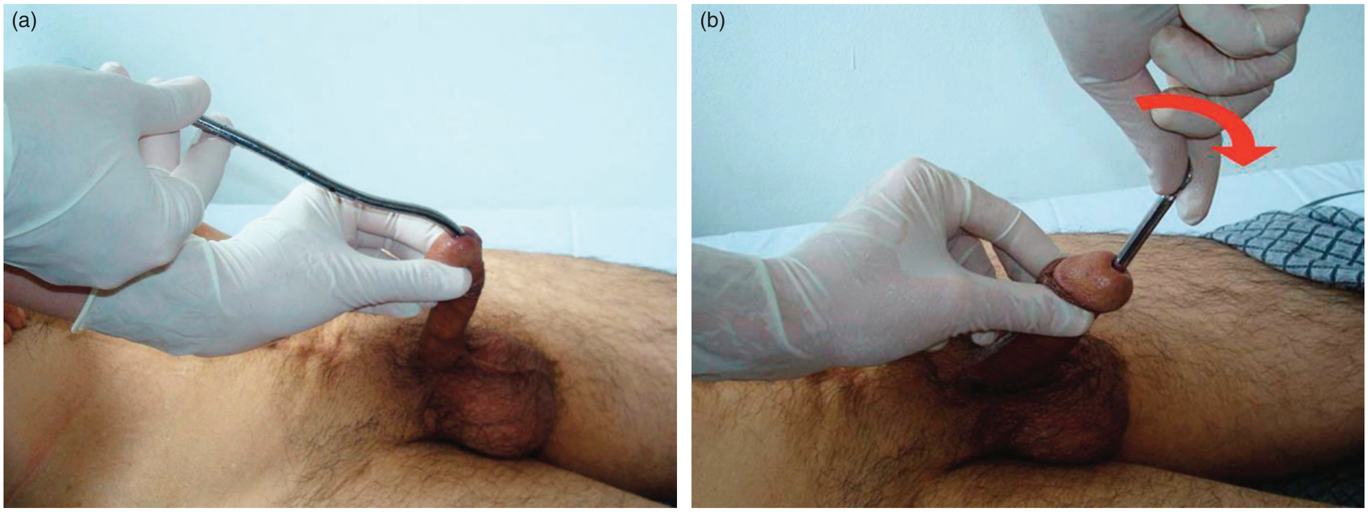

FIGURE 4.7 **Insertion of the dilator into the penile urethra (a), followed by ascension into the bulbar and prostatic urethra (b).**

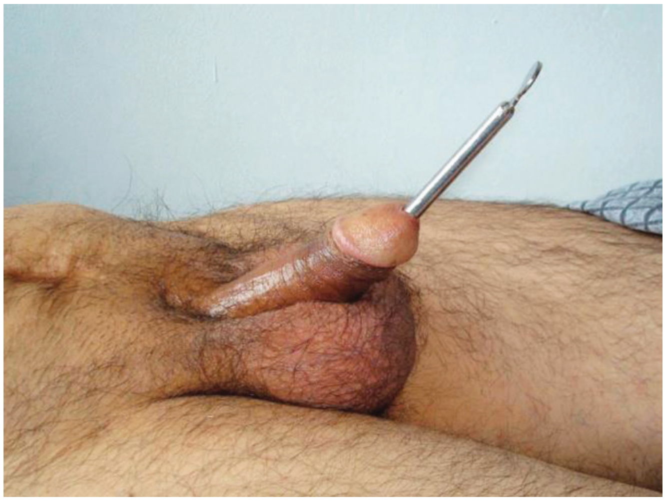

FIGURE 4.8 **Benique type metallic dilator in its final position.**

The process of insertion is complex and must be performed gently, to avoid injuring the urethral wall (which can lead to formation of false passages and to perforations). With the patient in dorsal decubitus, the dilator is inserted into the penile urethra, after tractioning the penis upward. Insertion continues, sliding the tip of the dilator along the dorsal wall of the urethra. When it reaches the bulbar region, a complex maneuver is performed, which associates a circular movement with the handle of the bougie downward, descending between the patient's thighs, and simultaneously pushing it, following the urethra's path (Figs 4.7 and 4.8). The dilators are maintained in position over a period of time ranging from 5 min to 20 min.

4.4.3 Urethral Dilation with Balloons

Catheters equipped with an inflatable balloon in their distal portion are used for performing this type of dilation. It has a length of 5–10 cm, a diameter (inflated) of 24–40F, and has two radiopaque markers at its ends.

With the patient in a lithotomy position, under local anesthesia, and under endoscopic control, a metallic guidewire is inserted up to the level of the urinary bladder. The balloon catheter is ascended on the guidewire, until the two markers are positioned superior and inferior to the stenosed segment, respectively. The balloon will then be inflated using 30–50% concentration contrast medium, until its median narrowing is erased. Dilation is performed for a period of 1–5 min (Daughtry et al., 1988). If the balloon is still deformed by the area of stricture, it is deflated and then again reinflated. Some authors recommend insertion of a urethro-vesical catheter at the end of the procedure for 48–72 h (Daughtry, 1989), while others do not recommend routine stenting (Mohammed and Wirima, 1988).

4.4.4 Hydraulic Self-Dilation

This implies clamping of the gland and of the distal portion of the urethra with the fingers during urination. Although the method is cheap and does not require a visit to the urologist, it does, however, present a series of shortcomings. Thus, the increased pressure may determine lesions of the urethral mucosa as well as urine extravasation, which can augment the spongiofibrosis process. For these reasons, hydraulic self-dilation must be applied with care and must not be used for a long period of time.

This method has also been associated with a series of infectious complications (orchiepididymitis, cystitis, pyelonephritis, etc.), with lithiasic complications and with vesicoureteral reflux, all of which represent further arguments against its routine application (Calomfirescu and Voinescu, 2001).

4.5 COMPLICATIONS

Frequently performed without visual or radiologic control, urethral dilations present potential complications, which may range from simple mucosal abrasions (Fig. 4.9) or bleeding, to perforations (Figs 4.10 and 4.11) and urethral false passages or perforations of the bladder.

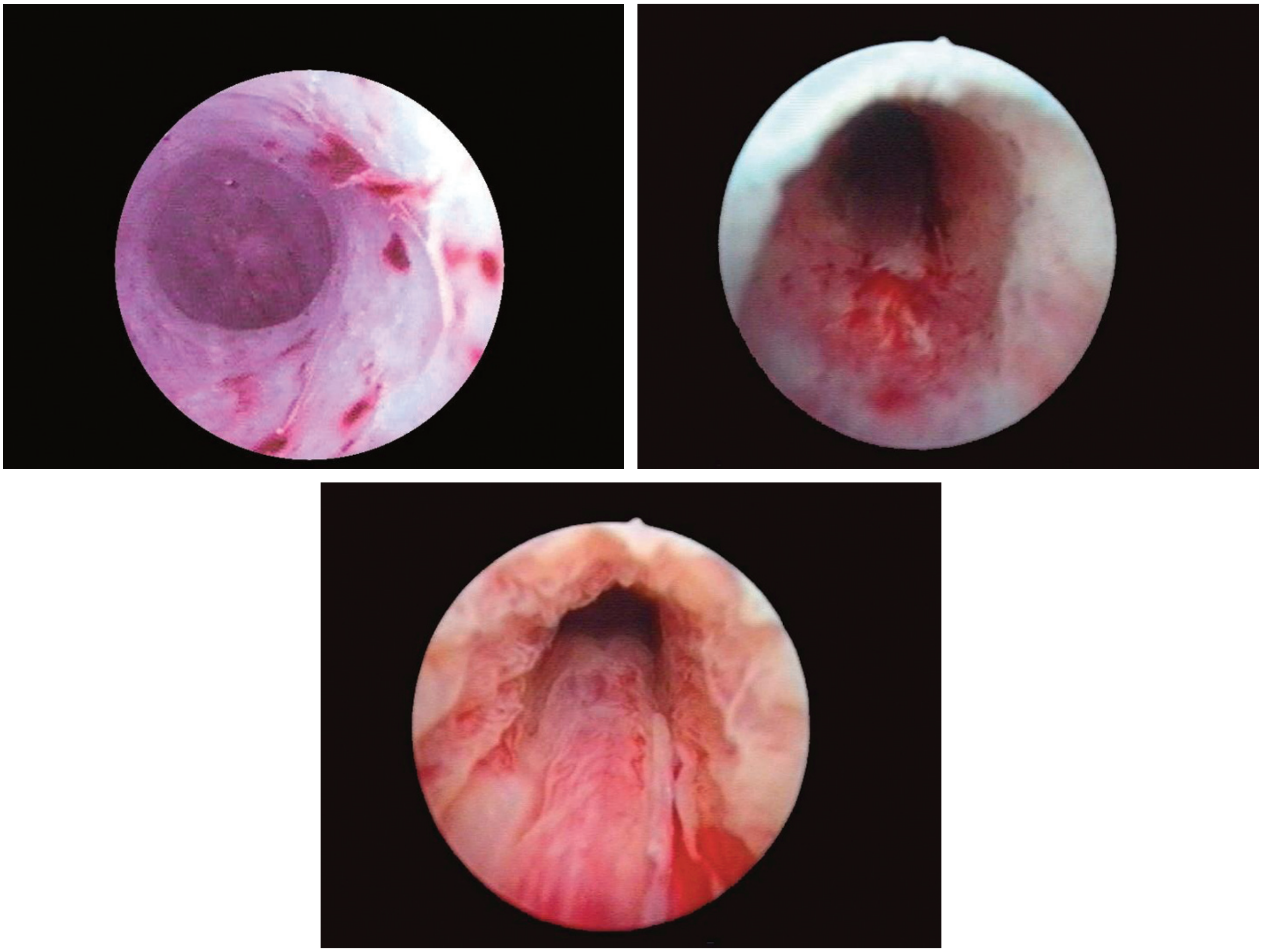

FIGURE 4.9 **Different aspects of urethral mucosa abrasions secondary to dilation.**

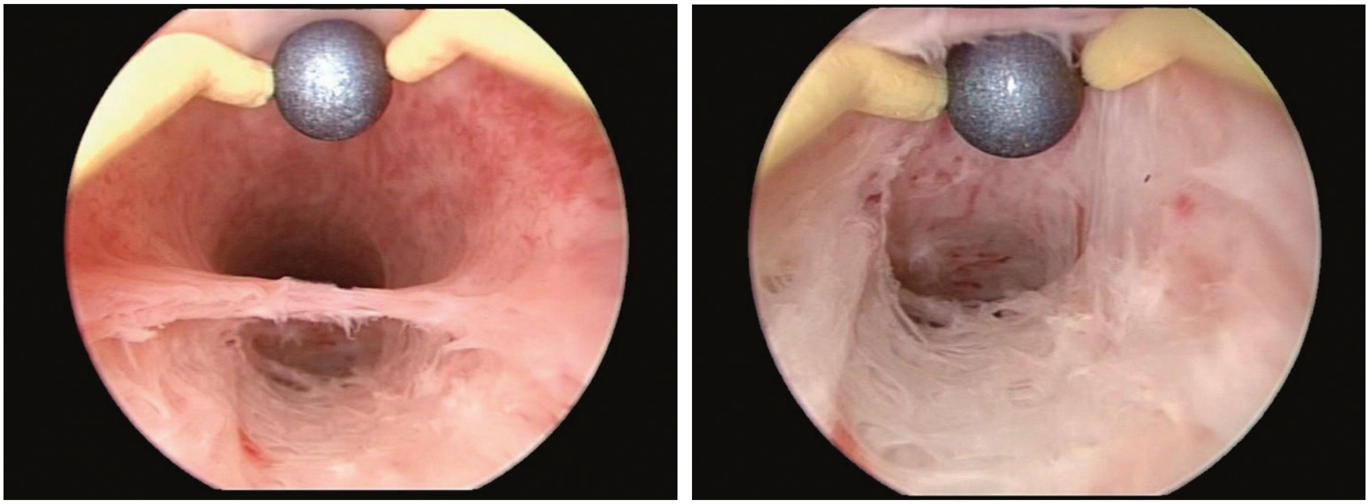

FIGURE 4.10 **Urethral false passage secondary to a "blind" dilation.**

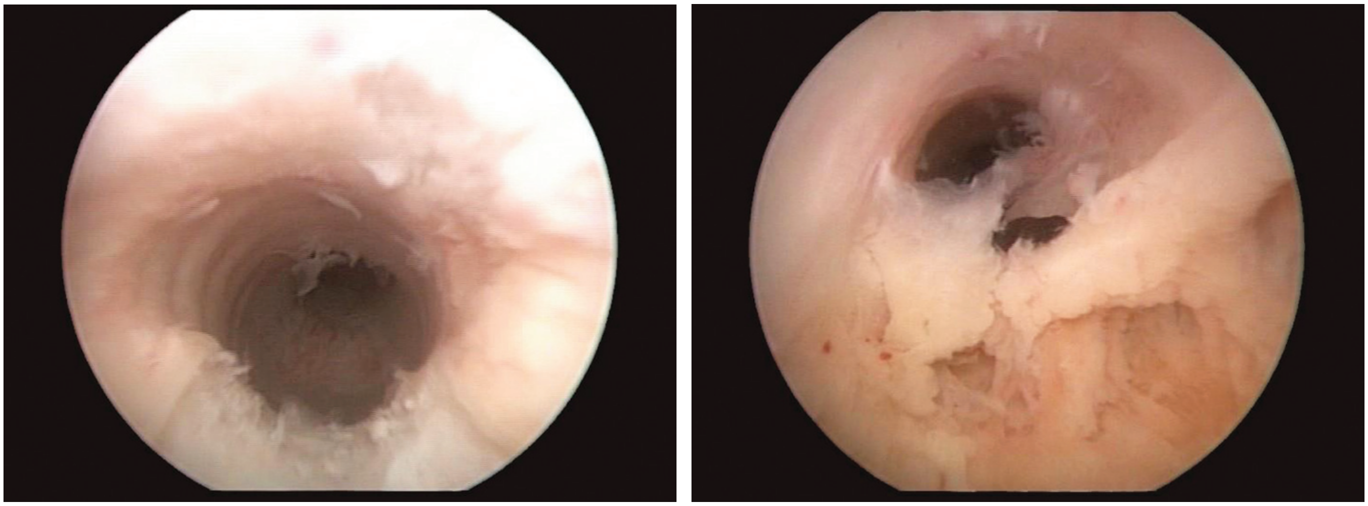

FIGURE 4.11 **Lesions of the urethral wall secondary to dilations.**

The rate of complications reported in the literature varies between 8% and 14%, while up to 18% of dilations fail from a technical point of view (Stormont et al., 1993; Steenkamp et al., 1997; Heyns, 2008).

Another category of postoperative complications that may be associated with urethral dilations is represented by infections: cystitis, periurethral abscesses, etc. This maneuver has a septic potential, which is why it is essential to respect the rules of asepsis and antisepsis, as well as to administer antibiotics (when necessary). A specific intraoperative incident is represented by the breaking of the dilation balloon.

Hydraulic self-dilation may determine the previously mentioned complications (pyelonephritis, epididymitis, reno-ureteral lithiasis, bladder lithiasis, and diverticula, etc.) (Calomfirescu and Voinescu, 2001).

4.6 RESULTS

Urethral dilations are procedures with a controversial efficacy, with mostly modest results being reported. Of the different types previously described, balloon dilation is preferred as first-line treatment. Due to its technical particularities, longitudinal traction forces are not exercised at the level of the urethra (as is the case with bougies or metallic dilators), but only eccentric forces are exercised. For this reason, balloon dilation presents a minimal potential morbidity (bleeding, false passages, etc.), and by avoiding interruption of mucosal continuity, production of additional scar tissue is minimal. Although studies published in the literature report immediate success rates (patent lumen) of 59–100%,

TABLE 4.1 Results of Urethral Dilation

Authors	No. of cases	Characteristics	Success rate (%)
Russinovich (1981)	7	Postinflammatory, posttraumatic	100
Giesy et al. (1984)	41	–	100
Acunas et al. (1988)	5	Iatrogenic	100
Daughtry et al. (1988)	9	Postinflammatory, posttraumatic	100
Mohammed and Wirima (1988)	6	–	66.6
Nishiyama et al. (1991)	2	Stricture of the entire urethra	100
Hübler and Solt (1991)	2	Important comorbidities	100
MacDiarmid et al. (2000)	51	–	84.3
Ramchandani et al. (1994)	27	Postprostatectomy	59

the majority of cases require redilations after a variable period of time, ranging from 3 days to 12 months (Table 4.1). Most studies that report 100% success rates include a low number of patients, followed over a limited period of time. Mohammed and Wirima (1988) reported a success rate of only 66.7% after a median follow-up period of 12 months.

Special attention must be paid to the study published by Nishiyama and coworkers in which, although only two cases are described, these presented stenosis of the urethra along its entire length. Both cases were successfully dilated using a balloon catheter (Nishiyama et al., 1991).

Ramchandani proposed using the method in patients with strictures of the vesico-ureteral anastomosis after radical prostatectomy, reporting a success rate of 59%, without recording any cases of urinary incontinence (Ramchandani et al., 1994).

The low efficacy, the potential complications (especially using bougies and metallic catheters), as well as the alteration of quality of life due to the permanent dependence of the patient on the urologist, have led to a decrease in the use of this method (as a primary approach of urethral strictures). Urethral dilation is currently indicated in a relatively reduced number of cases, and almost exclusively for consolidation and for preventing recurrences.

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CHAPTER

5

Endoscopic Treatment of Urethral Strictures in Women

Răzvan Mulţescu, Mihai Drăguţescu, Dragoş Georgescu, Bogdan Geavlete

5.1 GENERALITIES

Urethral strictures in women represent a rare pathological entity, which are part of the subvesical obstruction syndrome (Santucci et al., 2008). This heterogeneous syndrome may occur in 3–8% of women, associating functional causes (vesico-sphincterian dyssynergia, pelvic floor dysfunctions, etc.) and/or anatomical causes (meatus stenosis, strictures, calculi, tumors, etc.) (Fig. 5.1).

The incidence of urethral strictures in these patients ranges between 4% and 13%, the most frequent causes being iatrogenic lesions (Fig. 5.2), local trauma, and inflammatory disorders, which generate periurethral fibrosis (Keegan et al., 2008).

Iatrogenic lesions may be secondary to radiotherapy (with generation of fibrous tissue); prolonged catheterization; surgical interventions for diverticula, fistulas, or incontinence; and even excessive dilations, with bleeding and periurethral extravasation of urine (Migliari et al., 2006) (Fig. 5.3).

Due to the low incidence of this disease, both the number of studies in this field and the number of evaluated patients is limited. Unfortunately, endoscopic treatment of urethral stenoses is influenced not only by its excessive use in the past in disorders in which a clear benefit was not demonstrated in clinical trials, but also by the underestimation of the subvesical obstruction syndrome.

5.2 INDICATIONS

The main therapeutic options for urethral strictures in women are represented by urethral dilations, urethrotomy (Otis or optical), and urethroplasty.

Urethral dilations and urethrotomy used to be classically performed in a wide range of pathological entities (chronic cystitis, recurrent cystitis, dysuria, urine retention, strictures, etc.) (Netto Junior and da Silva, 1978; Libert, 1986; Stratev, 1995). Today, their indications have been drastically reduced to confirmed urethral strictures, and even these are subject to controversy. Some authors indicate urethroplasty as the primary method of surgical treatment, while others consider this type of management as exaggerated and recommend it only in case of persistent strictures after dilations or incisions (Schwender et al., 2006; Sharma et al., 2010; Gutiérrez Ruiz et al., 2009).

Despite these, urethral dilations in women continue to be performed on a wide scale, unjustified by results from clinical trials regarding their utility in the whole variety of conditions, which determine inferior urinary tract symptoms. Thus, an evaluation performed in the United States of America underlined the fact that urethral dilations in women are performed in 929 of 100,000 patients (almost as frequently as the treatment of strictures in men), although the incidence of this pathological entity is significantly lower in women. However, the use of empirical indications is less and less seen among urologists in general, especially among those who performed their training in urology after 1989 (Santucci et al., 2008).

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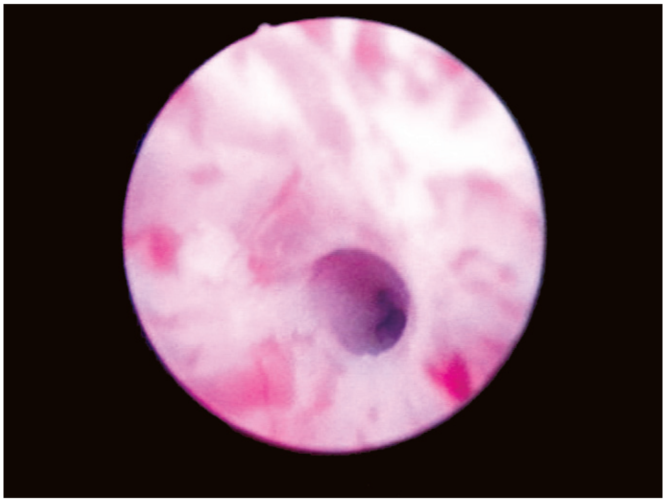

FIGURE 5.1 Urethral stricture in a woman.

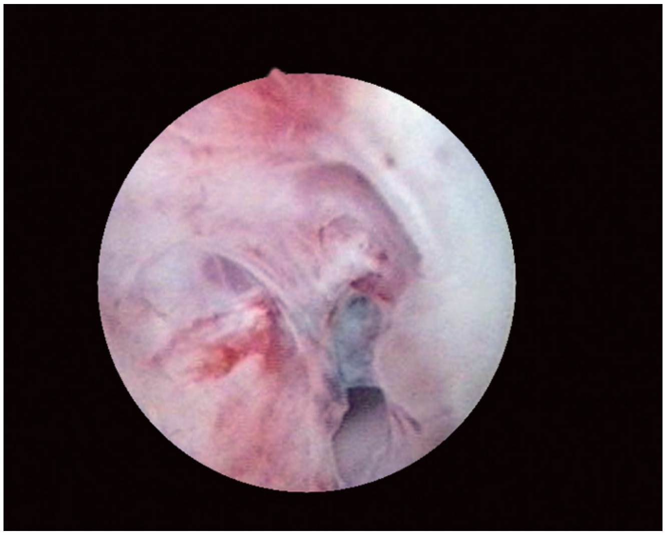

FIGURE 5.2 Iatrogenic urethral stricture in a woman, with a false passage secondary to an attempt of urethro-vesical catheter indwelling.

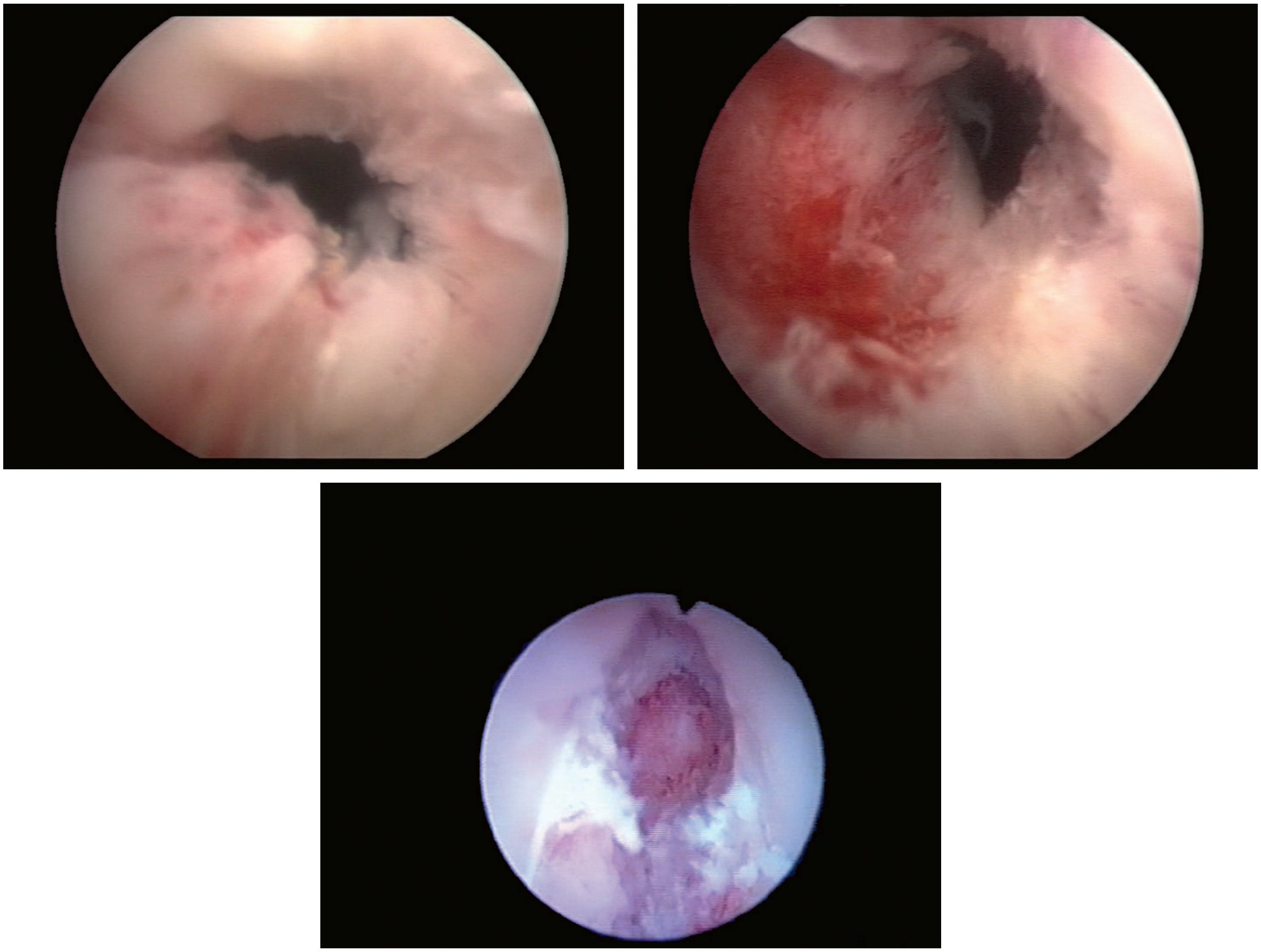

FIGURE 5.3 Different endoscopic aspects of iatrogenic urethral stenosis in a woman.

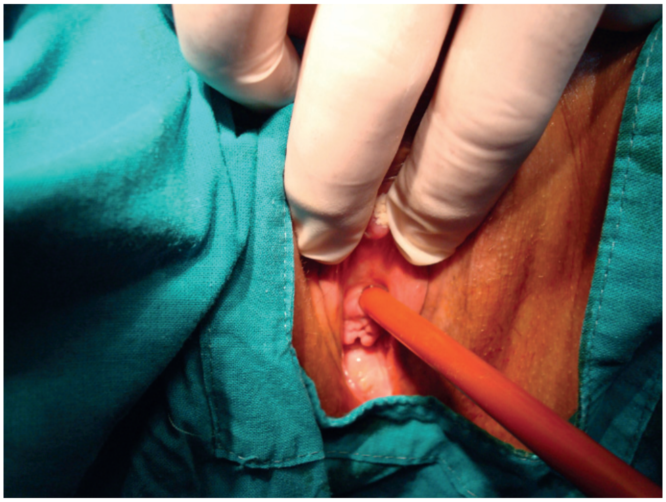

FIGURE 5.4 **Dilation of a female urethra with bougies.**

It is presently considered that urethral dilations (Fig. 5.4) represent the method of choice in the treatment of urethral strictures in women who refuse urethroplasty and who do not accept the risk of incontinence associated with optical internal urethrotomy, or in whom more invasive interventions are contraindicated. These patients must accept a potential subsequent program of periodic redilations or of intermittent autocatheterization (Takao et al., 1992; Smith et al., 2006).

Compared with urethroplasty, optical urethrotomy is a cheaper, simpler, quicker, and less invasive therapeutical option for urethral strictures in women. However, its efficacy does not reach 100% and presents the risk of urinary incontinence by injuring the striated sphincter.

Technological progress and the development of new therapeutical methods have not rendered this procedure obsolete, but have introduced new indications. A special category of indications, which has appeared due to the large-scale use of minimally invasive surgery for incontinence in women, includes patients with urine retention or urethral erosions after mounting TVT or TOT suburethral slings (Webster and Gerridzen, 2003). The incidence of obstructive phenomena after this type of surgical intervention ranges between 1.9% and 19.7% in the case of retropubic slings (Abouassaly et al., 2004; Barber et al., 2006) and 0–15.6% in the case of transobturator slings (Delorme et al., 2004; Fischer et al., 2005). In these patients, urethral dilations and intermittent catheterization are recommended in the period immediately after surgery. Incision of the sling may be required in 0.1–7% of cases with persistence of symptoms (Daneshgari et al., 2008). Urethral erosion is a complication that occurs in 0.3% of cases, usually due to faulty surgical techniques, which alters vascularization of the urethral wall, or due to repeated dilations in patients with obstructive symptoms (Karram et al., 2003; Webster and Gerridzen, 2003; Daneshgari et al., 2008). One of the methods proposed for the treatment of these cases is represented by optical urethrotomy and excision of the sling by vaginal approach (Wijffels et al., 2009).

Urethroplasties, although performed on a large scale in the treatment of urethral strictures in men, are less frequently applied in female patients. Despite the fact that clinical trials indicate a similar efficacy in patients of this gender, they are complex and expensive interventions compared with the endoscopic alternatives (Montorsi et al., 2002; Smith et al., 2006; Schwender et al., 2006).

5.3 TECHNIQUES

5.3.1 Anesthesia

Similar to the treatment of male urethral strictures and, in theory, much simpler from a technical point of view, optical internal urethrotomies in women may be performed under local, spinal, or general anesthesia. The first two types of anesthesia are most commonly used.

5.3.2 Positioning of the Patient

Urethrotomy in women is performed with the patient in the classical lithotomy position, the genitoperineal and inferior abdominal areas being asepticized and draped with sterile fields.

5.3.3 Dilation of the Urethral Meatus and the Urethra

Access to the strictured area may be prevented by the coexistence of a stenosis of the urethral meatus or by the caliber of the underlying urethra. In these conditions, insertion of the endoscope is preceded by recalibration of the urethral conduct with bougies. The maneuver should be performed gently, with a progressive increase of the diameter of the bougies, and carefully in order to avoid creating false passages. Recalibration of the urethral lumen may be stopped in this phase, or may be continued with the urethrotomy.

5.3.4 Urethrotome Insertion

Insertion of the urethrotome is performed under direct visual control.

5.3.5 Biopsy

In case of any suspicion of malignant lesions, multiple biopsies must be collected from the site of the pathological segment, followed by extemporaneous histologic examination.

5.3.6 Incision

The urethrotomy incision is similar to that performed in men, with some differences due to the anatomy of the female urethra and to etiological particularities. Due to the short length of the urethra, additional precautions are necessary to avoid sectioning of the sphincter and potential urinary incontinence.

5.3.6.1 Position of the Incision

The position of the incision is chosen depending on the etiology of the stenosis. Thus, in case of simple intrinsic stenoses, the incision is performed at 12 o'clock (to avoid creating urethro-vaginal fistulas) (Fig. 5.5). In patients with subvesical obstruction or erosions after installing slings, it is performed at 6 o'clock.

5.3.6.2 Type of Incision

The incision may be performed with a cold, electric (Fig. 5.6), or laser scalpel, and their rules and particularities are identical to those described previously, in the section dedicated to optical internal urethrotomy in men.

5.3.7 Cystoscopy

Cystoscopy must end any endoscopic urethral intervention, with the purpose of identifying eventual complications, as well as any potential associated intravesical lesions.

5.3.8 Urethro-Vesical Catheter Indwelling

At the end of the urethrotomy, a vesical catheter is inserted for a variable period of time. In urethrotomies in patients with suburethral slings, this catheter should be maintained for as short a time as possible, so as not to prevent epithelialization and not to maintain the ends of the bandelet exposed in the urethral lumen (Wijffels et al., 2009).

5.3.9 Associated Lesions Treatment

5.3.9.1 False Passages

These may frequently complicate urethral strictures, and are usually iatrogenic as the result of attempts of unexpected catheterizations. When important septa are created, these may be abolished by incision with cold, electric (Fig. 5.7), laser scalpels, or by electroresection.

5.3.9.2 Urethral and Vesical Calculi

Vesical and urethral calculi are rare disorders, which may complicate urethral strictures in women. Their treatment is detailed in Chapter 6.

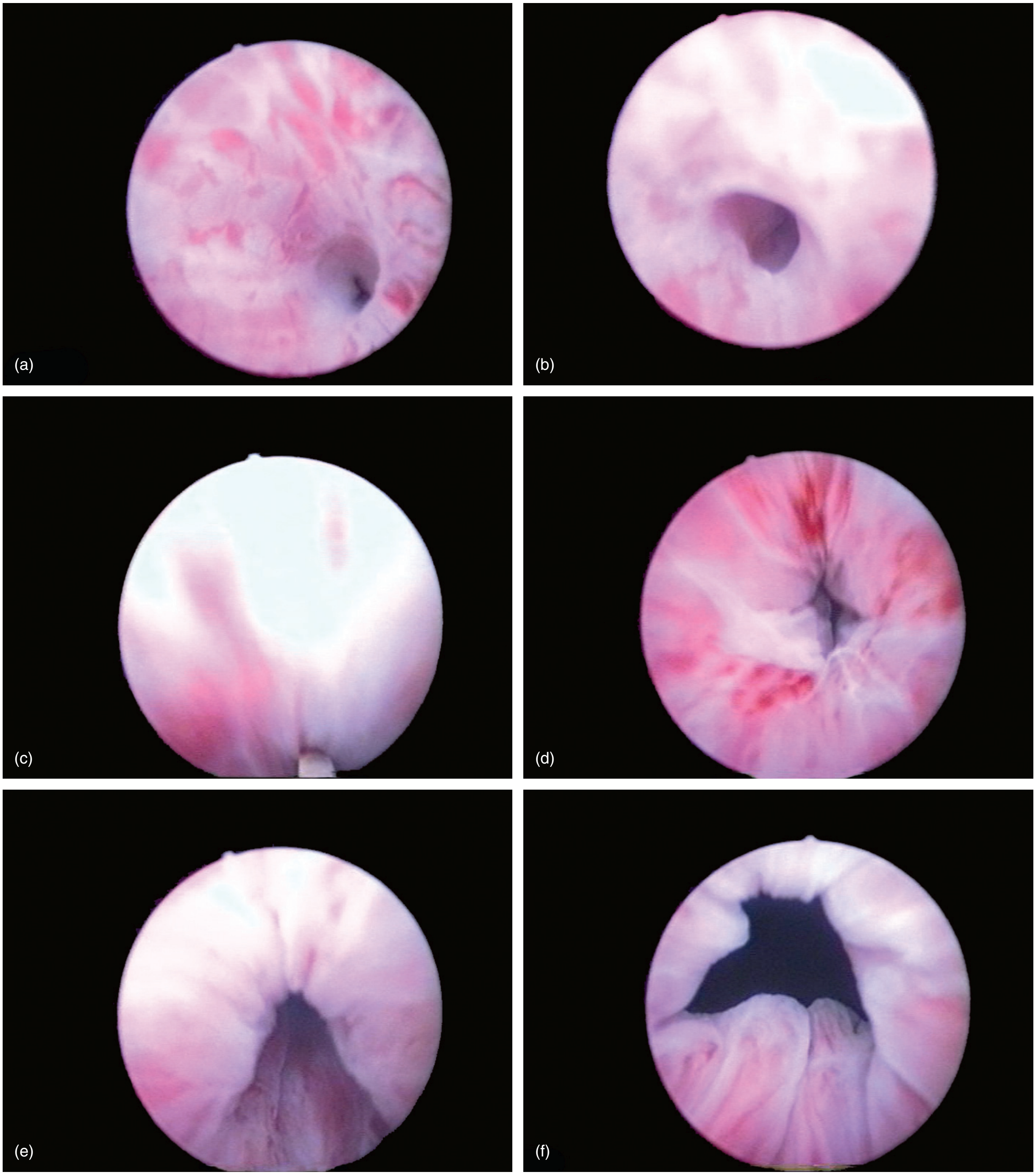

FIGURE 5.5 Urethral stricture (a, b) for which incision at 12 o'clock is performed (c) until recalibration of the lumen (d); normal aspect of the overlying area (e) and of the bladder neck (f).

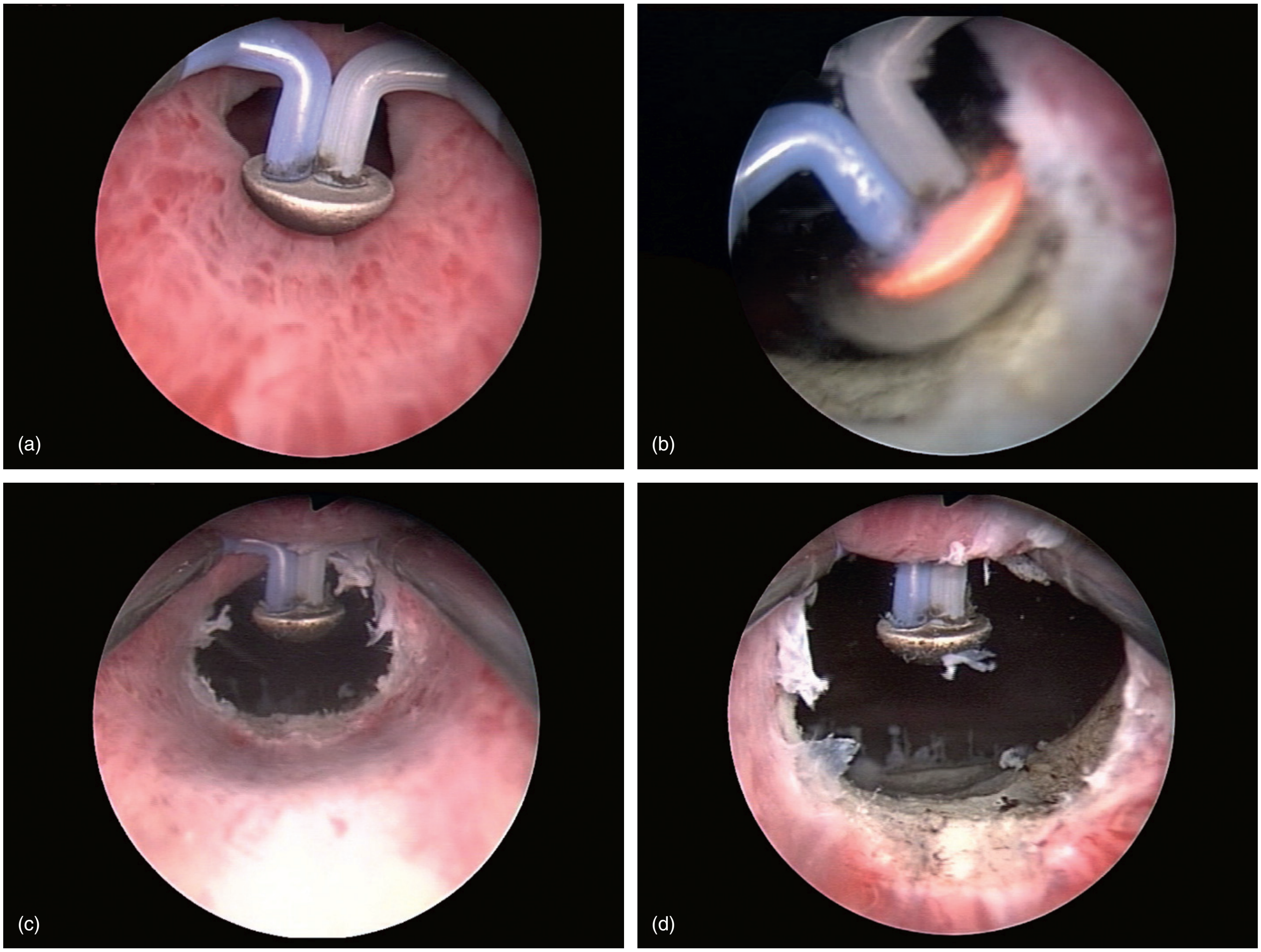

FIGURE 5.6 **Bladder neck stenosis in woman (a), for which plasma electrovaporization was performed in saline solution (b) until a lumen of satisfactory caliber was obtained (c, d).**

5.3.9.3 Suburethral Bandelets

Suburethral bandelets' incision may be followed, especially if they are accompanied by urethral erosions, by their excision, usually by transvaginal approach (Wijffels et al., 2009). In cases where autologous tissue bandelets are used, urethrotomy alone is sufficient (Webster and Gerridzen, 2003).

5.4 COMPLICATIONS

5.4.1 Intraoperative Complications

5.4.1.1 Major Bleeding

Major bleeding may occur as a result of injury to neighboring vascular structures. Insertion of a large caliber urethro-vesical catheter can control the bleeding.

5.4.1.2 False Passages and Urethral Perforation

False passages may occur in case of brutal dilations of the urethra or in case of uncontrolled incisions.

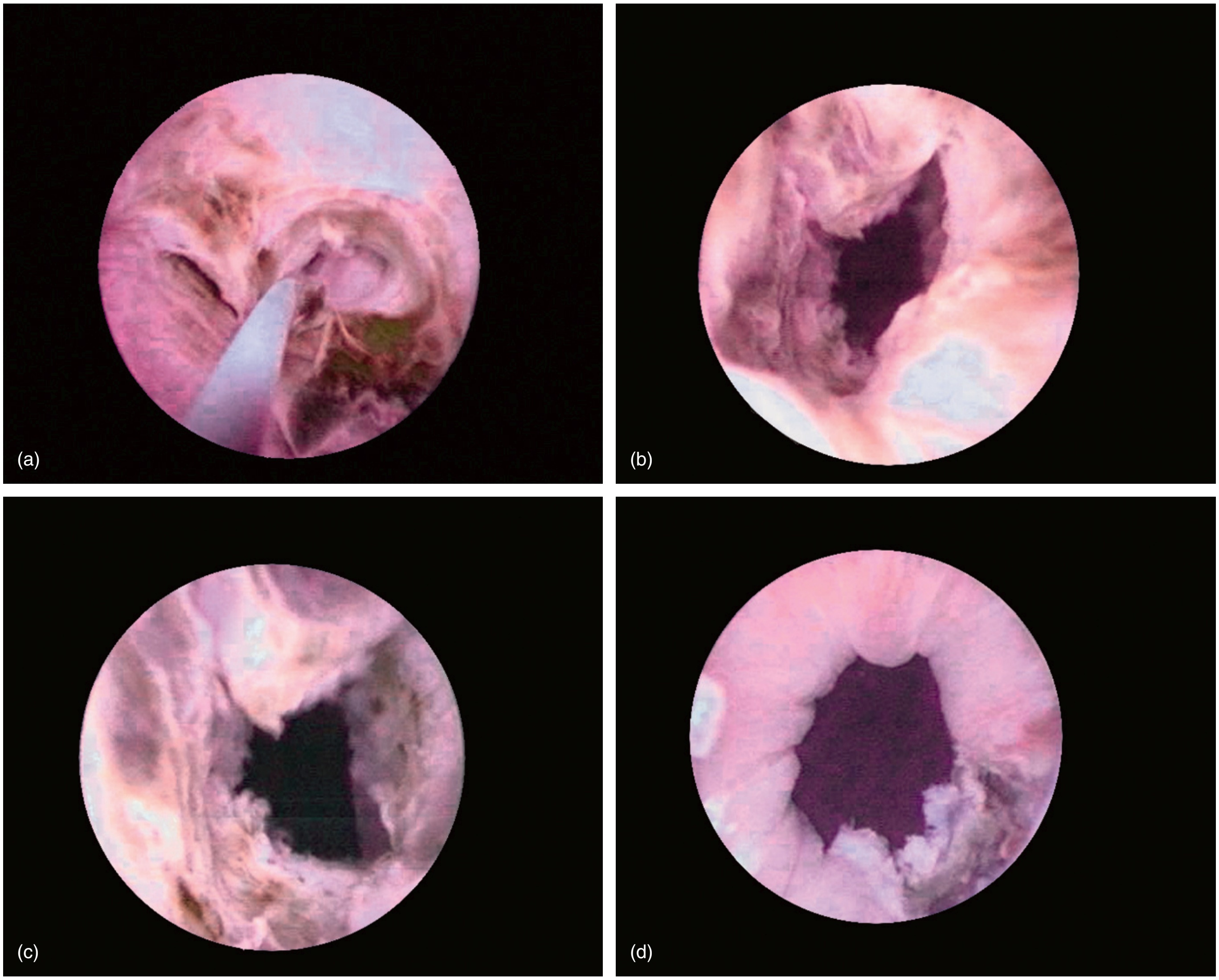

FIGURE 5.7 **Urethral stricture with false passage (a), for which electroresection is performed (b, c) with preservation of the sphincter (d).**

5.4.2 Postoperative Complications

5.4.2.1 Infections

As in the case of optical internal urethrotomy in men, different infectious complications (cystitis, periurethritis, etc.) may also occur in women after this intervention.

5.4.2.2 Urethro-Vaginal Fistulas

These may complicate optical internal urethrotomies in women in the case of deep incisions at 6 o'clock.

5.4.2.3 Restenosis

Restenosis is probably the most frequent late complication after endoscopic treatment of urethral strictures in women.

5.4.2.4 Urinary Incontinence

This usually occurs when, due to a faulty technique, the striated sphincter is injured during the incision of the stricture. The risk of developing this complication is increased by the fact that, the female urethra being short, the strictured area is frequently in the proximity of the sphincterian region.

5.5 RESULTS

Periodic urethral dilations represent an acceptable therapeutic option in patients who have contraindications or who refuse more invasive options, and who accept periodic redilations or subsequent intermittent autocatheterization. Smith et al. (2006) studied seven patients with urethral strictures recalibrated by dilation up to 30F and intermittent autocatheterization, and reported good and stable results in all cases after a median follow-up of 21 months.

Being a rare disorder, there are no large studies that describe the results of optical internal urethrotomy for the treatment of urethral strictures in women. However, endoscopic incision is considered to be an acceptable alternative in the case of patients in whom dilations have failed; it is much simpler and cheaper compared to urethroplasty, but presents, however, the risk of urinary incontinence.

Regarding urethrotomy as part of the intervention for obstructive or erosion-generating suburethral slings, although the number of reported cases is not high, the results are promising (Webster and Gerridzen, 2003; Wijffels et al., 2009).

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CHAPTER

6

Treatment of Urethral Lithiasis and Foreign Bodies

Petrişor Geavlete, Răzvan Mulţescu, Dragoş Georgescu, Bogdan Geavlete

6.1 URETHRAL LITHIASIS IN MALES

6.1.1 Generalities

Urethral lithiasis is a rare disorder (Fig. 6.1), representing 1–2% of cases of urinary lithiasis in developed countries. In developing countries, the risk of disease occurrence is even higher, probably due to the increased number of patients with bladder stones (Amin, 1973; Koga et al., 1990; Hemal and Sharma, 1991; Maheshwari and Shah, 2005).

The factors that favor urethral lithiasis are represented by urethral obstacles (urethral strictures, etc.) (Fig. 6.2), congenital urethral diverticula (Fig. 6.3), parasitosis (schistosomiasis, etc.), urethral foreign bodies, intraluminal hair strands (after urethroplasty), and infections with urease-positive bacteria (Fig. 6.4) (Rodríguez Martínez et al., 2000; Recasens Guinjuan et al., 2002).

Several classifications exist for urethral lithiasis:

- depending on the origin
  - native (primitive)
  - migrated (secondary)
- depending on the segment in which it is located
  - lithiasis of the posterior urethra (Fig. 6.5)
  - lithiasis of the anterior urethra (a particular location of these stones being represented by lithiasis of the navicular fossa)

In men, the majority of stones migrate and stop at the urethral level due to the presence of an obstacle. Secondary stones may increase in size in this segment.

Some authors estimate that approximately 40–56% of stones are located in the posterior urethra, while 10% are diagnosed in the navicular fossa (Englisch, 1904; Amin, 1973; Sharfi, 1991) (Fig. 6.6). In other series, such as those of Koga or of Kamal, only 16–22% of cases presented with stones in the anterior urethra (Koga et al., 1990; Kamal et al., 2004).

6.1.2 Indications

Choosing the optimal therapeutic option in patients with urethral lithiasis depends on the position and size of the stone, on the associated urethral diseases, and on the status of the urethra (recently migrated stone, chronic obstacle with impaction, etc.). Endoscopic lithotripsy can be performed in most cases, with very good results. Stones in the anterior urethra may also be "blindly" extracted using open surgical tweezers, or may be mobilized by manual maneuvers, after lubricating the urethra with an anesthetic gel (El-Sherif and El-Hafi, 1991). However, these methods present an increased risk of injuring the wall (Rodríguez Martínez et al., 2000; Maheshwari and Shah, 2005).

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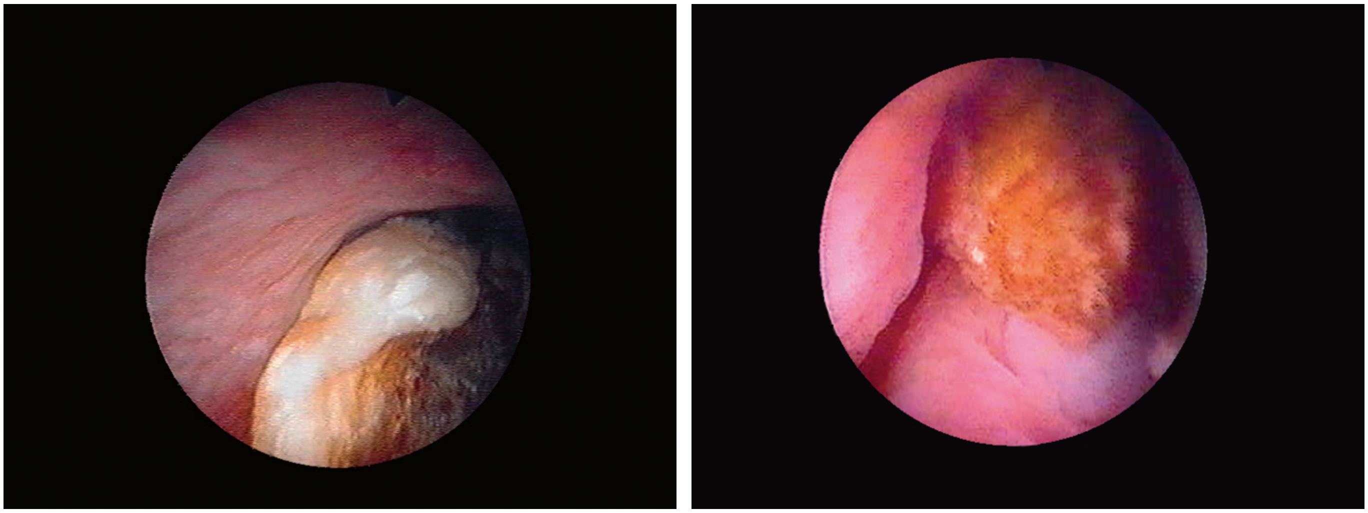


FIGURE 6.1 Different aspects of urethral stones.

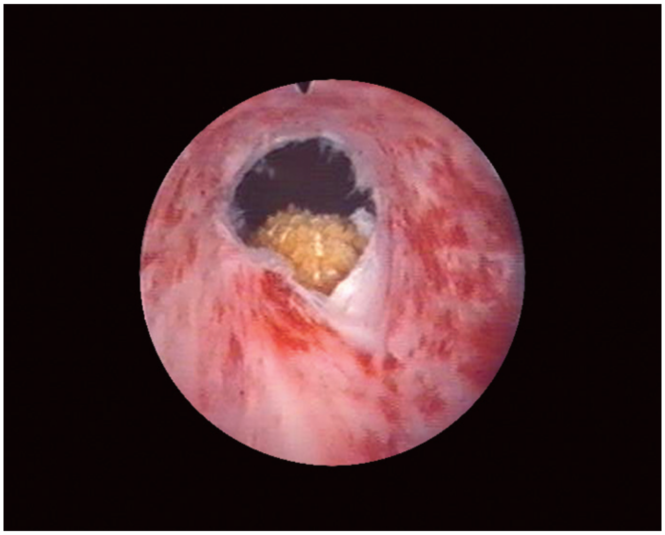


FIGURE 6.2 Urethral lithiasis overlying a bulbar stricture.

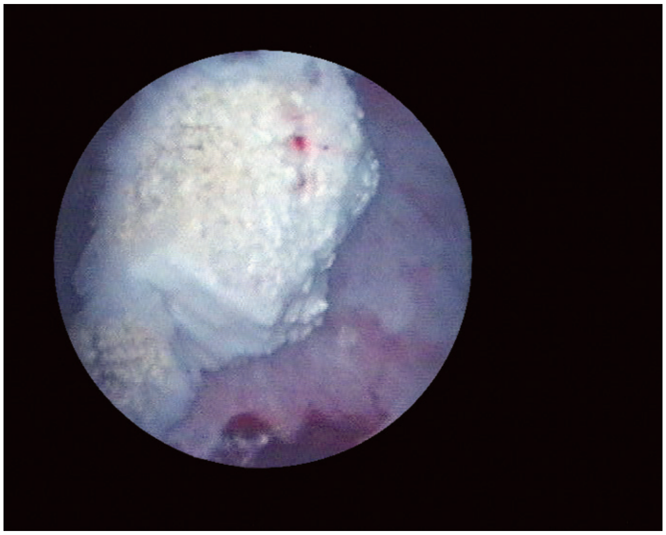


FIGURE 6.3 Urethral lithiasis in a patient with urinary infection.

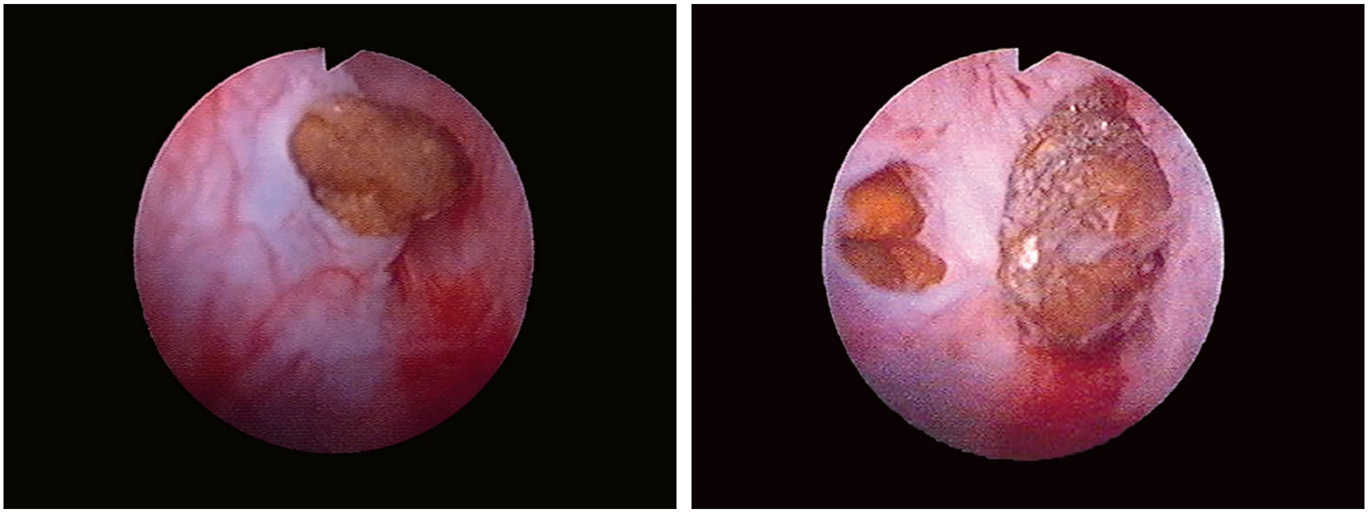


FIGURE 6.4 Lithiasis in a urethral diverticulum.

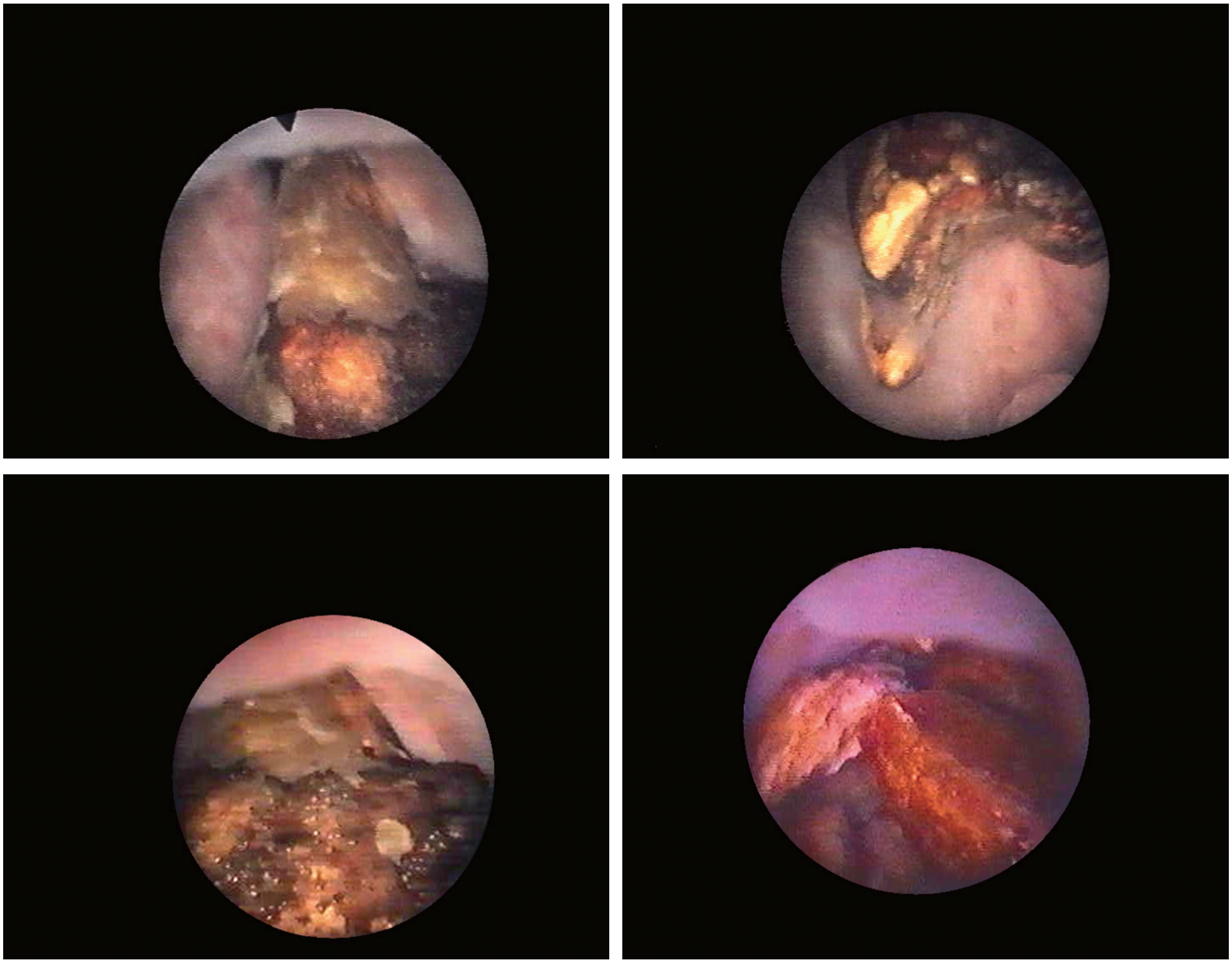


FIGURE 6.5 Lithiasis of the prostatic urethra.

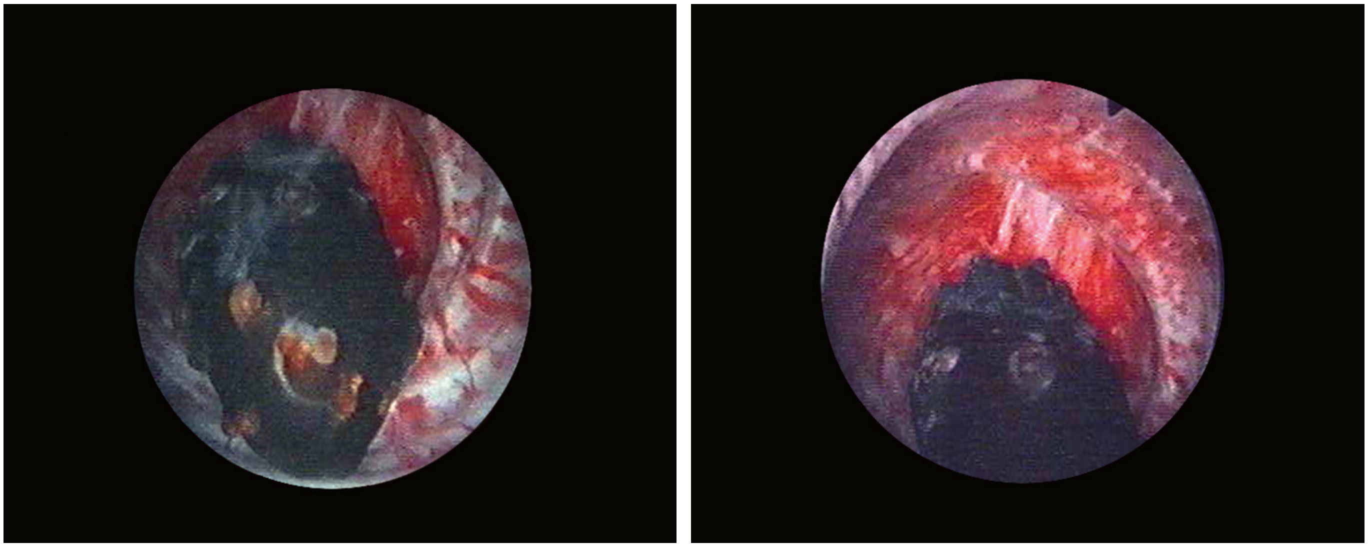


FIGURE 6.6 Bulbar urethral lithiasis.

Stones that have been impacted for a longer period of time may require an open approach, through external urethrotomy, extraction, and double-layer urethrorrhaphy. If lithiasis is secondary to a urethral diverticulum, then open intervention with diverticulectomy and urethroplasty is almost exclusively indicated.

6.1.3 Techniques

6.1.3.1 Patient Positioning

Interventions for extracting urethral stones and for resolving associated lesions are performed with the patient positioned for lithotomy, draped with sterile fields in a way similar to that described for optical internal urethrotomy.

6.1.3.2 Anesthesia

Intervention is performed under local, locoregional, or general anesthesia. Anesthetic requirements generally do not exceed those necessary for the endoscopic treatment of urethral strictures.

6.1.3.3 Suprapubic Cystostomy

It is necessary to perform a minimal suprapubic cystostomy in patients with urethral lithiasis and complete urine retention. Insertion of a urethro-vesical catheter must not be attempted due to the risk of creating false passages, which will complicate the intervention even more.

6.1.3.4 Obtaining Access to the Stone

Most cases being associated with an underlying urethral obstacle, the actual approach of the stone is preceded by recalibration of the urethral lumen. Incision or dilation of the urethral meatus is necessary if the lithiasis is located in the navicular fossa. When the stones are located in other areas of the urethra, proximal to a urethral stricture, its incision may be performed by any of the previously described methods (Fig. 6.7).

6.1.3.5 Extraction of the Stone

Small stones may be extracted in whole, using forceps (Fig. 6.8) or a basket catheter. In case of voluminous stones, these must be fragmented in order to be extracted (Fig. 6.9).

Lithotripsy may be performed with any type of efficient energy source: ballistic (Wadhwa et al., 1994) (Fig. 6.10), ultrasonic (Durazi and Samiei, 1988), electrohydraulic (Selli et al., 1984), laser (Walker and Hamilton, 2001; Maheshwari and Shah, 2005), etc. Due to the characteristics of the probes, ballistic or ultrasonic fragmentation requires the use of a right working channel urethrocystoscope.

Anterior urethral stones must be fragmented *in situ*. For stones of the posterior urethra, lithotripsy may be performed locally (Fig. 6.11) or after their relocation in the prostatic cavity (more distensible) (Figs 6.12 and 6.13) or in the urinary bladder, in which case they are treated as bladder stones. After lithotripsy, the resulting fragments are evacuated using extraction forceps (Fig. 6.14) or basket catheter.

Retrograde pushing without visual control has also been proposed, after instilling gel with lidocaine on the urethra, followed by processing of the stone in the urinary bladder. However, this method presents the risk of urethral injury, which is why this method must be abandoned after one or two failed attempts and the switch made to visual control (El-Sherif and Prasad, 1995; Maheshwari and Shah, 2005).

6.1.3.6 Cystoscopy

Cystoscopy is performed to highlight associated lesions of the bladder, especially concomitant bladder stones.

6.1.3.7 Treatment of Associated Lesions

The treatment of urethral strictures has been previously described. Patients with urethral lithiasis may present associated bladder stones, which will also be fragmented and extracted. A special mention should be made regarding lithiasis developed on strands of hair at the level of a cutaneous graft used for urethral reconstruction in patients with hypospadias. Lithotripsy of the stones should be followed by laser or chemical depilation (trimestrial instillations with thyoglycolate) of the urethra for preventing recurrences (Singh and Hemal, 2001).

6.1.3.8 Urethro-Vesical Catheter Indwelling

At the end of the intervention, a urethro-vesical catheter is inserted and is maintained for a variable period of time, depending on associated diseases. If the urethral lithiasis was secondary to a stricture, the period of time is

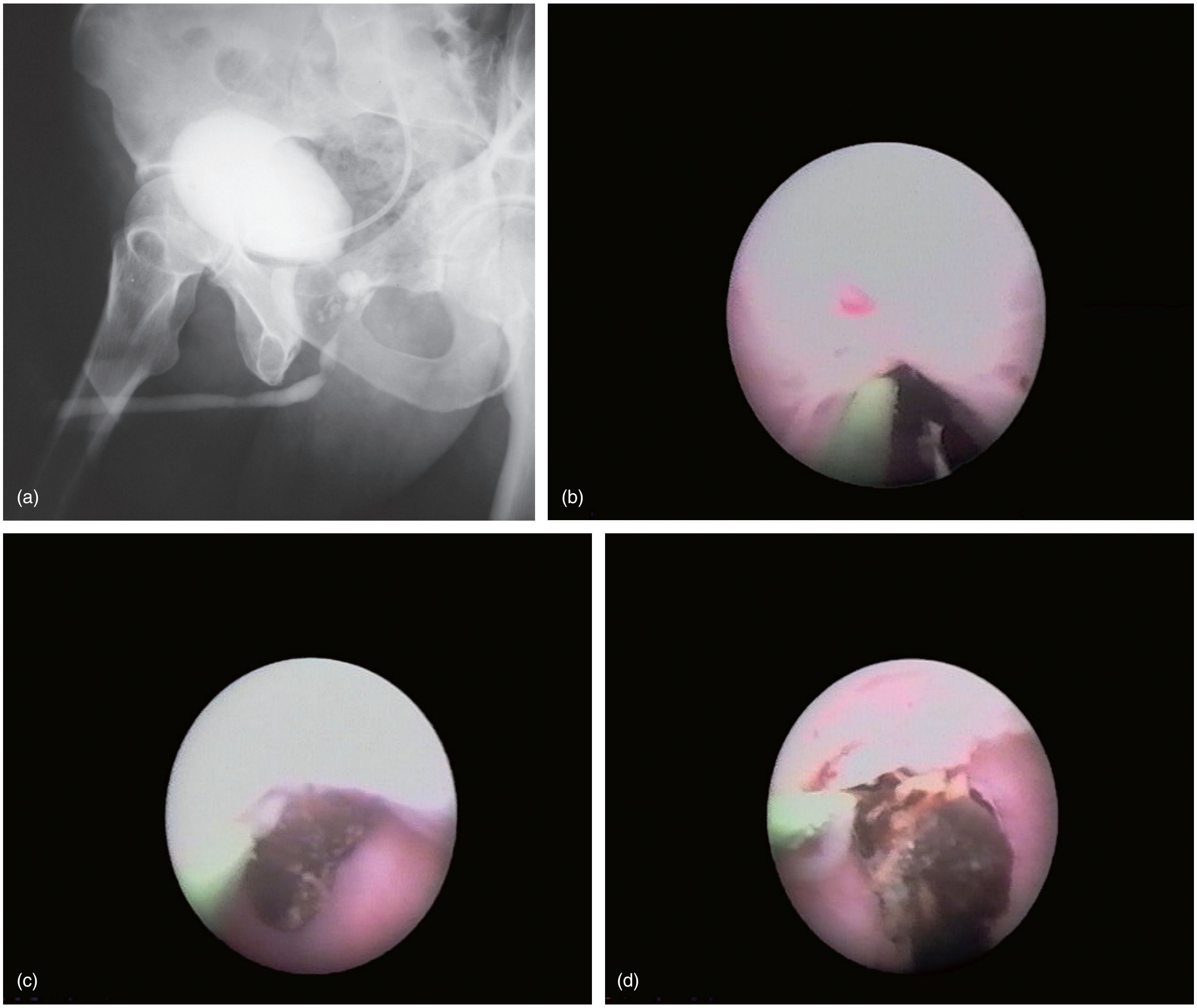


FIGURE 6.7 **Stricture of the bulbar urethra visualized by retrograde urethrography (a). After optical urethrotomy with cold scalpel (b), an overlying urethral stone is identified (c, d).**

determined using the criteria presented in the section dedicated to optical internal urethrotomy. If the patient does not present urethral strictures, the catheter is maintained for 12–24 h (Maheshwari and Shah, 2005).

6.1.4 Complications

The aim of treatment of urethral lithiasis is to remove the foreign body, cure any potential associated disease, and, implicitly, remove the subvesical obstacle without injuring the urethral wall or the periurethral tissue. However, a series of complications may occur, associated with endoscopy or with the use of different energy sources.

6.1.4.1 Injuries of the Urethral Wall

Injuries may vary from simple abrasions to false passages. Extraction of larger stones or fragments of stones must be done carefully, ensuring compliance of the lumen in order to avoid tearing or even avulsion of the urethral wall.

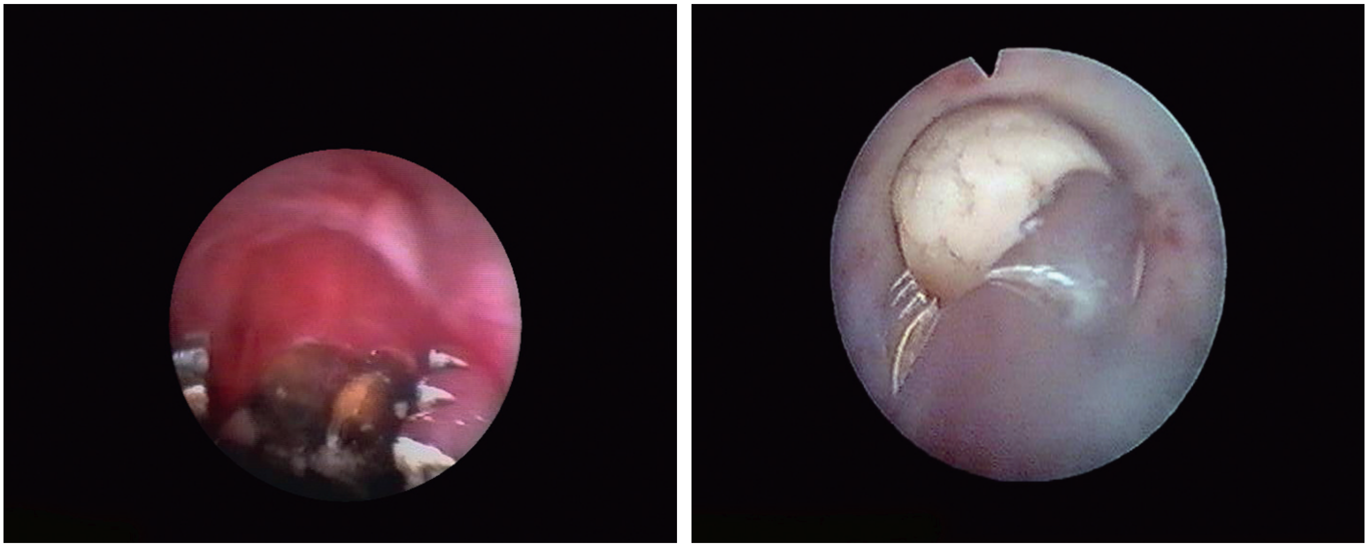


FIGURE 6.8 **Extraction in whole of urethral stones using forceps.**

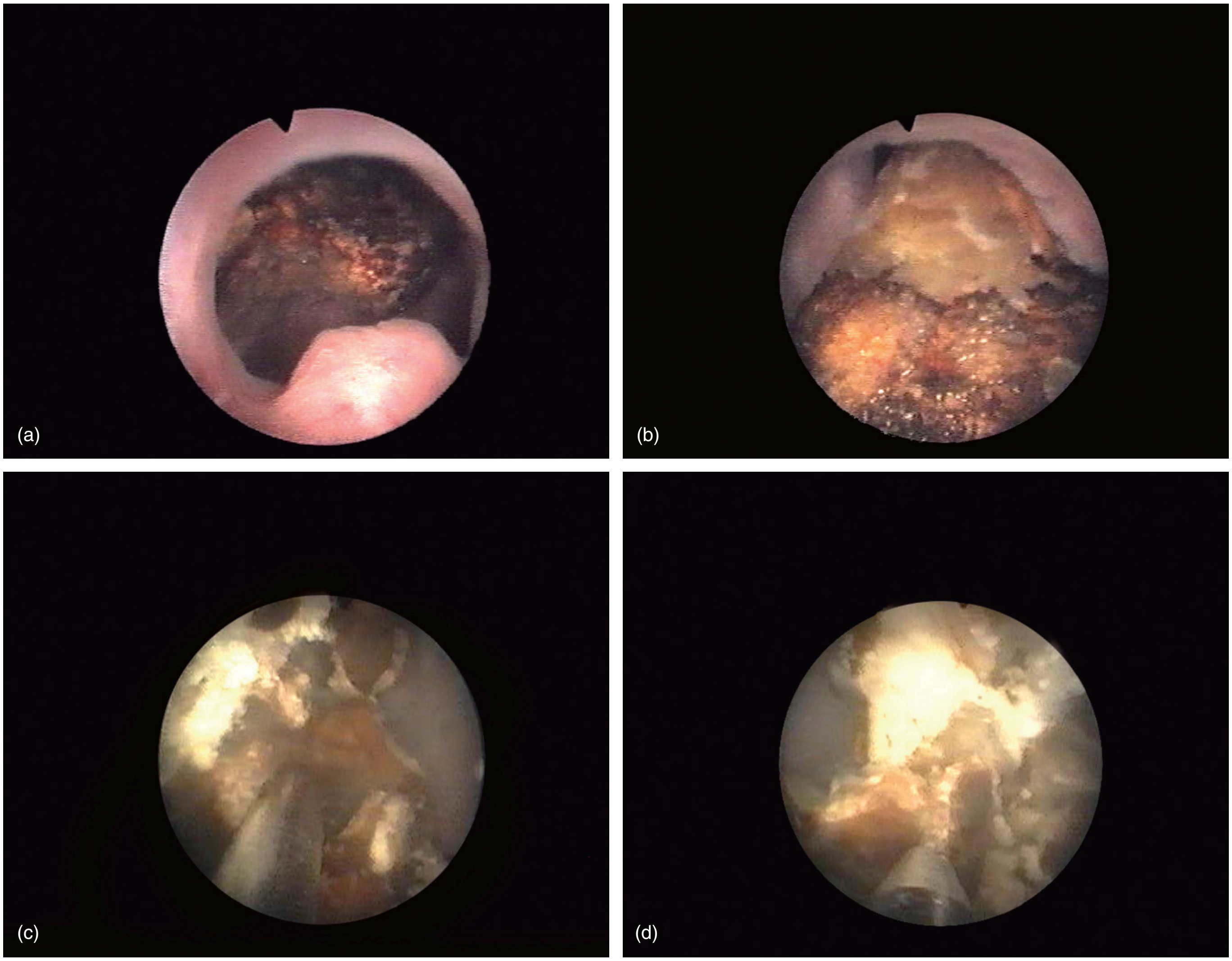


FIGURE 6.9 **Stone located in the prostatic urethra (a, b), ballistic fragmentation *in situ* (c, d).**

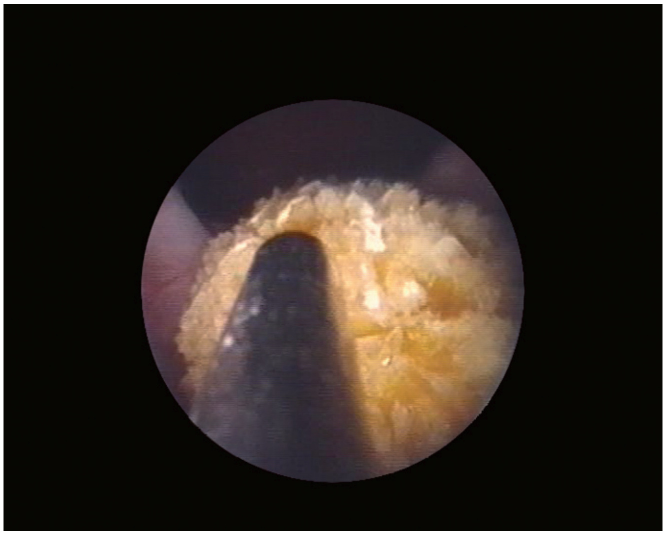


FIGURE 6.10 Ballistic lithotripsy of a urethral stone.

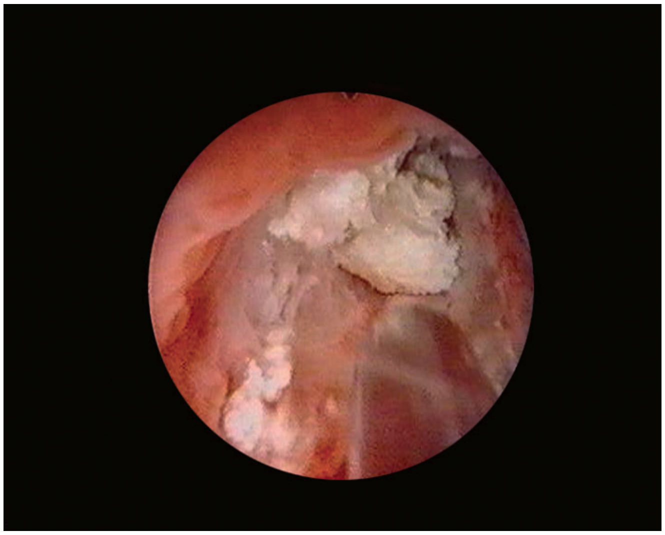
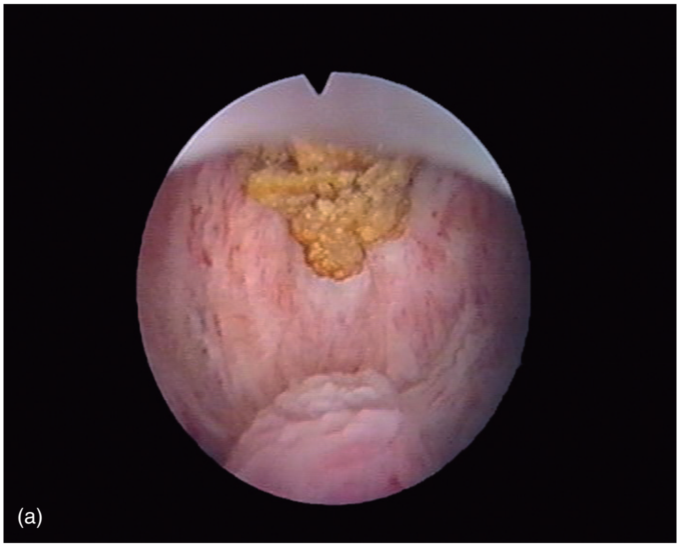


FIGURE 6.11 *In situ* lithotripsy of a stone located in the posterior urethra.



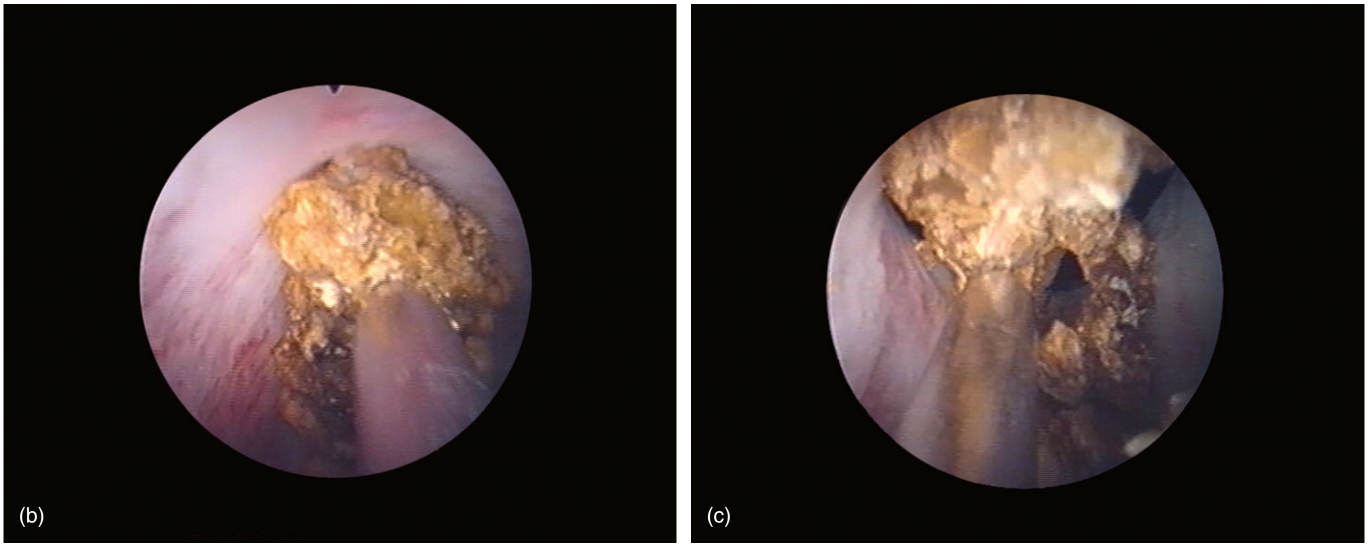


FIGURE 6.12 Urethral stone pushed retrogradely into the prostatic cavity (a), fragmented at this level (b, c).

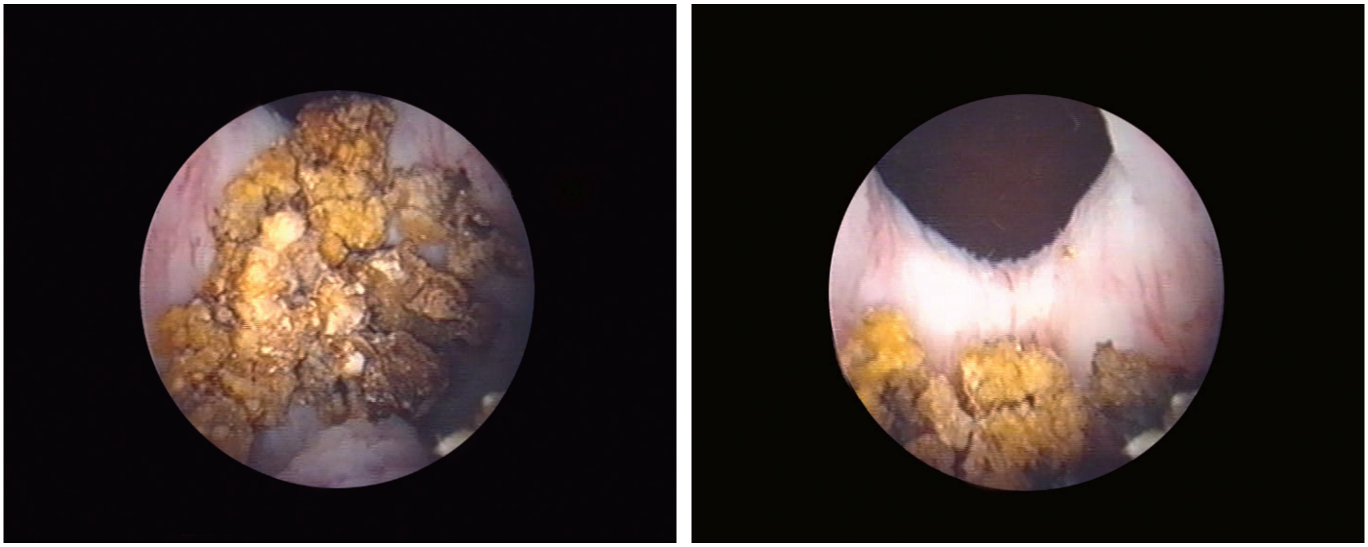


FIGURE 6.13 Aspect of the stone fragments resulting after ballistic lithotripsy.

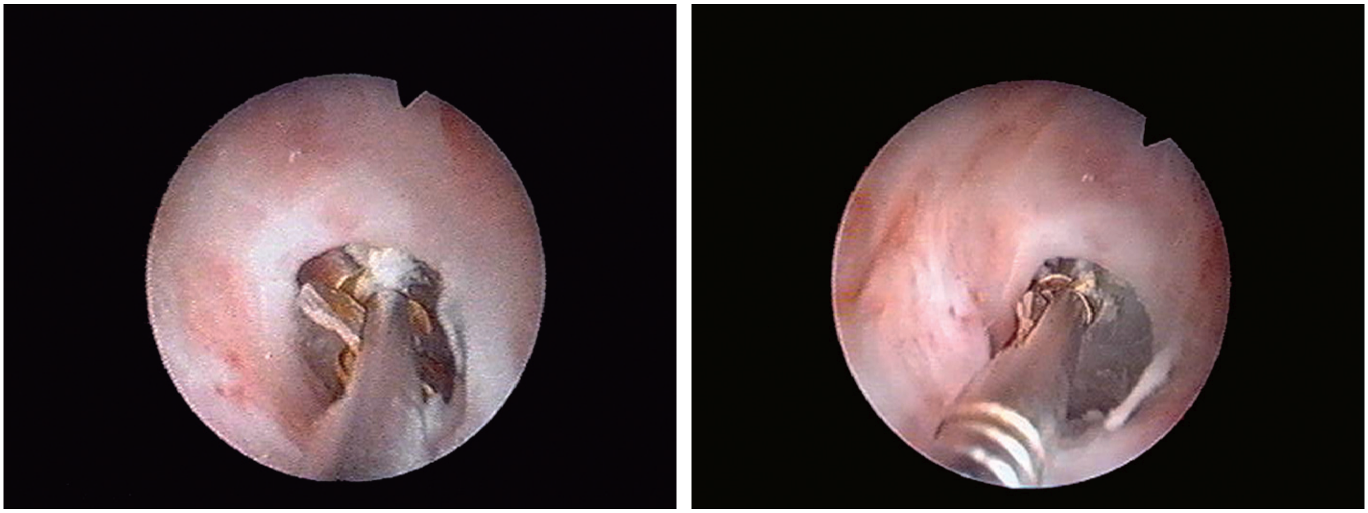


FIGURE 6.14 Extraction using forceps of stone fragments resulting after ballistic lithotripsy of a urethral stone.

6.1.4.2 Bleeding

Bleeding may be a consequence of parietal injury, especially during lithotripsy. It is usually clinically insignificant, and its management requires at the most insertion of a larger caliber urethro-vesical catheter.

6.1.4.3 Extraurethral Migration of Stone Fragments

Extraurethral migration of stones (Fig. 6.15) may occur in the case of uncontrolled lithotripsies. Fragments that remain in this position may initiate spongiofibrosis, with unfavorable consequences on the patency of the urethral lumen. For this reason, they must be carefully extracted with forceps, so as not to worsen the parietal defect (Figs 6.16 and 6.17).

6.1.4.4 Urethral Strictures

Sometimes, endoscopic treatment of urethral lithiasis in patients without obstructive disease at this level may generate, in time, a urethral stricture. However, the incidence of this complication is low, and it is more often a consequence of previous attempts of manual anterograde manipulation (so-called "milking" of the stone) (Maheshwari and Shah, 2005).

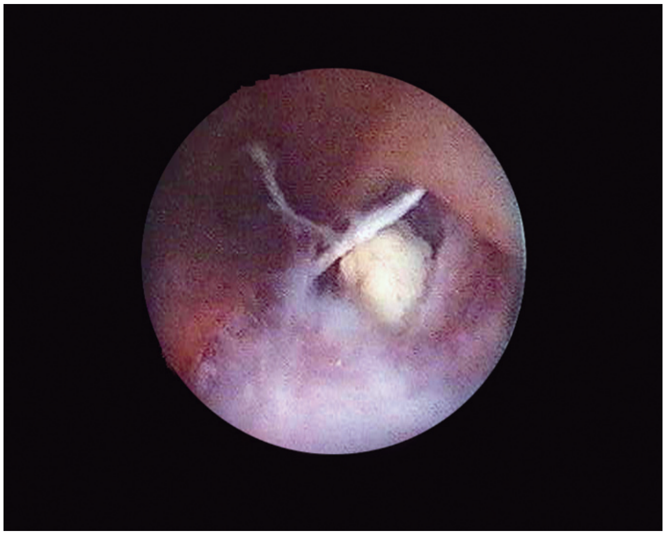


FIGURE 6.15 **Urethral stone with submucous migration.**

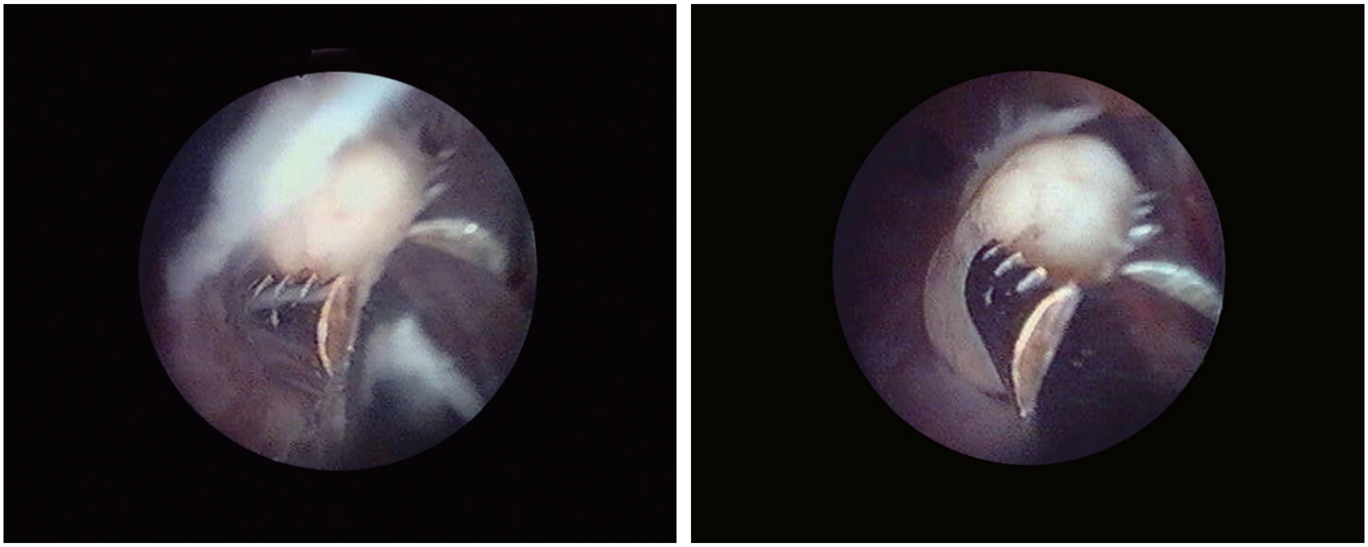


FIGURE 6.16 **Extraction of the stone using forceps with submucous migration.**

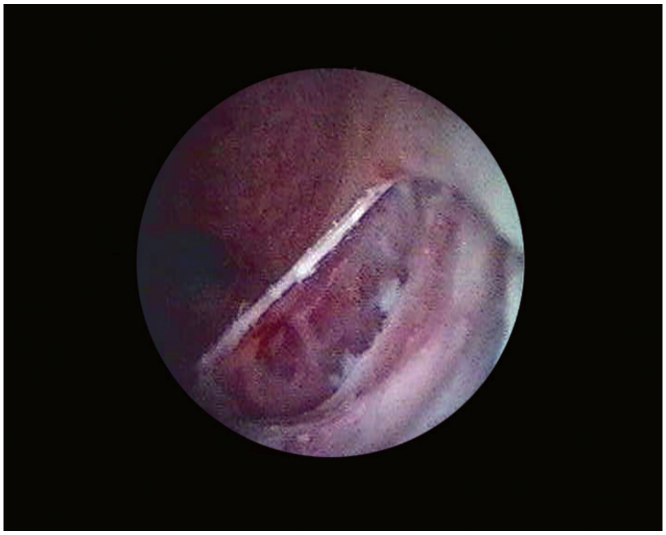


FIGURE 6.17 **Aspect of the parietal lesion after extraction of the stone.**

6.1.5 Results

The success rate for the endoscopic approach of urethral lithiasis (Fig. 6.18) is almost 100%, regardless if they are fragmented *in situ* (Fig. 6.19), in the prostatic cavity (Fig. 6.20), or in the urinary bladder (Selli et al., 1984) (Table 6.1). The choice for another type of approach is usually dictated by the presence of associated lesions, such as urethral strictures.

Sharfi (1991) estimated that around 33% of cases also present stones in other segments of the urinary apparatus, while 47% also present another lower urinary disease, of which 42% are urethral strictures.

Koga and Sharfi applied a transurethral endoscopic approach in approximately 58% of cases, with a success rate of almost 100% and without significant associated morbidity (Koga et al., 1990; Sharfi, 1991). Maheshwari attempted retrograde pushing of urethral stones into the urinary bladder, after instilling gel with lidocaine. In the 42.3% of patients in whom this method failed, *in situ* Ho:YAG lithotripsy was performed and all patients were stone-free after only one procedure (Maheshwari and Shah, 2005).

For the treatment of urethral stones unassociated with strictures, El-Sherif proposed retrograde manipulation of stones into the bladder and their fragmentation at this level by extracorporeal lithotripsy. The method was successfully applied in 60.6% of the 33 patients studied. However, in the remaining 39.4% of cases, fragmentation and endoscopic extraction of the stones was necessary. The authors recommend this method for all urethral stones unassociated with strictures before attempting endoscopic treatment, especially in pediatric patients (El-Sherif and

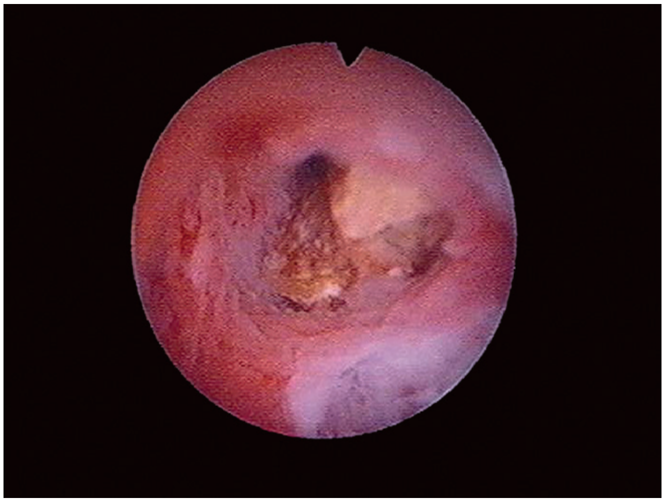


FIGURE 6.18 **Stone impacted in the bulbar urethra.**

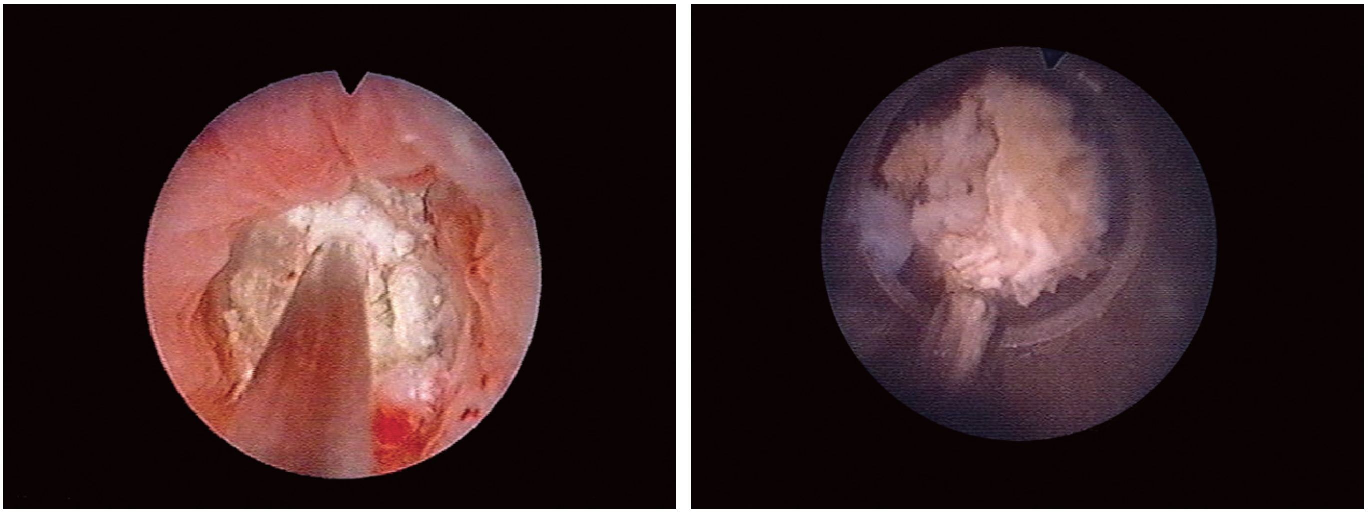


FIGURE 6.19 **Ballistic lithotripsy of the urethral stone.**

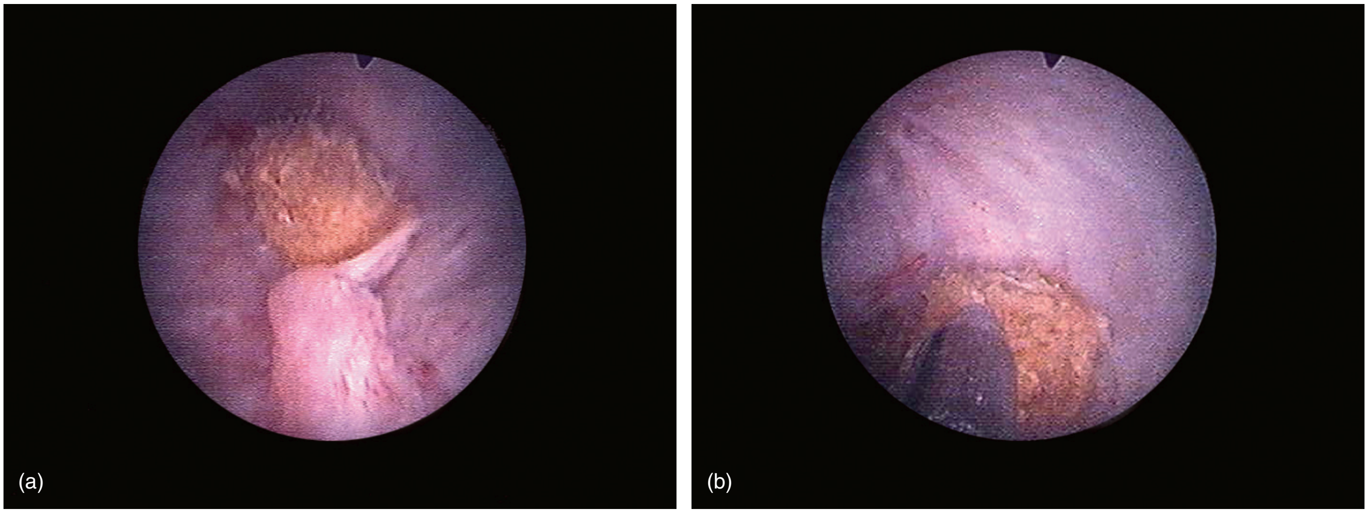


FIGURE 6.20 **Stone fragment migrated in the prostatic cavity (a), fragmented at this level (b).**

TABLE 6.1 Results of Urethral Foreign Body Treatment

Authors	No. of cases	Endoscopic treatment (%)	Success rate (%)
Maheshwari and Shah (2005)	42	100	100
Walker and Hamilton (2001)	2	100	100
El-Sherif and Prasad (1995)	33	39.4	100
Wadhwa et al. (1994)	2	100	100
Sharfi (1991)	36	58	100
Koga et al. (1990)	56	58.9	100
Durazi and Samiei (1988)	7	100	100
Selli et al. (1984)	14	42.9	100

Prasad, 1995). However, the safety and simplicity of the transurethral approach recommend this method as the first therapeutical option.

6.2 URETHRAL LITHIASIS IN WOMEN

6.2.1 Generalities

Urethral lithiasis in women (Fig. 6.21) is a rare pathological entity due to anatomical particularities. Because the female urethra is much shorter, a migrated stone is much easier to eliminate compared to the same disease in men. Also, the incidence of urethral strictures is much lower in women, further reducing the possibility of a stone lodging or developing at this level. Urethral lithiasis in women is most frequently associated with the presence of urethral diverticula or of urethrocele.

6.2.2 Indications

The modality of solving urethral lithiasis in women is practically dictated by the therapeutic option required for the associated and favoring disorders. Thus, the presence of large urethral diverticula usually calls for an open approach, with diverticulectomia and ligature of the neck or urethroplasty. However, endoscopic cure may be attempted in case of small diverticula, with incision of the septum between the diverticula and the urethra and extraction of the intradiverticular stones, if applicable.

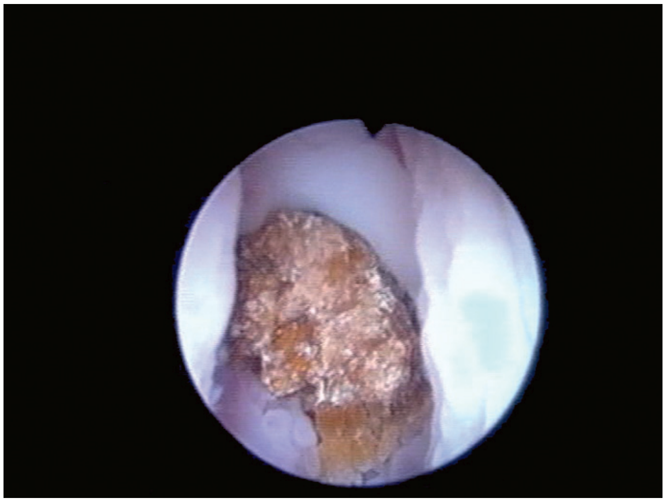


FIGURE 6.21 **Stone impacted at the level of the urethral meatus in a female.**

Some authors have recommended endoscopic cure of intradiverticular lithiasis followed by open surgical correction of the diverticulum in a secondary intervention, after a period of time necessary for the remission of local inflammatory phenomena (Susco et al., 2008). A urethral stricture with overlying lithiasis may also benefit from an endoscopic cure, with urethrotomy and fragmentation of the stone.

6.2.3 Techniques

6.2.3.1 Patient Positioning

The patient is placed in the classical position for lithotomy, adequately draped with sterile fields.

6.2.3.2 Anesthesia

This type of intervention is usually performed under local or spinal anesthesia.

6.2.3.3 Obtaining Access to the Stone

Obtaining access to the stone most frequently requires solving the cause of the lithiasis. Thus, in the case of diverticula, an incision of the septum between the cavity and the urethral lumen is performed (using cold, electric, or laser scalpel), while urethrotomy is preferred in the case of strictures.

6.2.3.4 Processing and Extraction of Stones

Small stones can be extracted in whole using forceps or baskets, while voluminous lithiasis requires ballistic, electrohydraulic, ultrasonic, or laser lithotripsy before extraction. Fragmentation usually takes place in the urinary bladder after pushing the stone upward. This maneuver is much easier in women than in men due to the short length of the urethra. However, large stones impacted in the urethra may require *in situ* fragmentation (Figs 6.22 and 6.23).

6.2.3.5 Urethro-Vesical Catheter Indwelling

At the end of the intervention, a urethro-vesical catheter is inserted and maintained in position for 12–24 h.

6.2.4 Results

An endoscopic approach of urethral lithiasis in women provides excellent results; the anatomical particularities making this intervention much easier than in men. What may prove difficult is the efficient management of the causes that led to the development of this very rare disorder: strictures, diverticula, etc.

The management of these disorders is described in detail in the corresponding chapters. A special mention must be made regarding the necessity of a prudent and careful technique while extracting/processing urethral stones, thus avoiding iatrogenic lesions, which could amplify the initial favoring conditions of its occurrence.

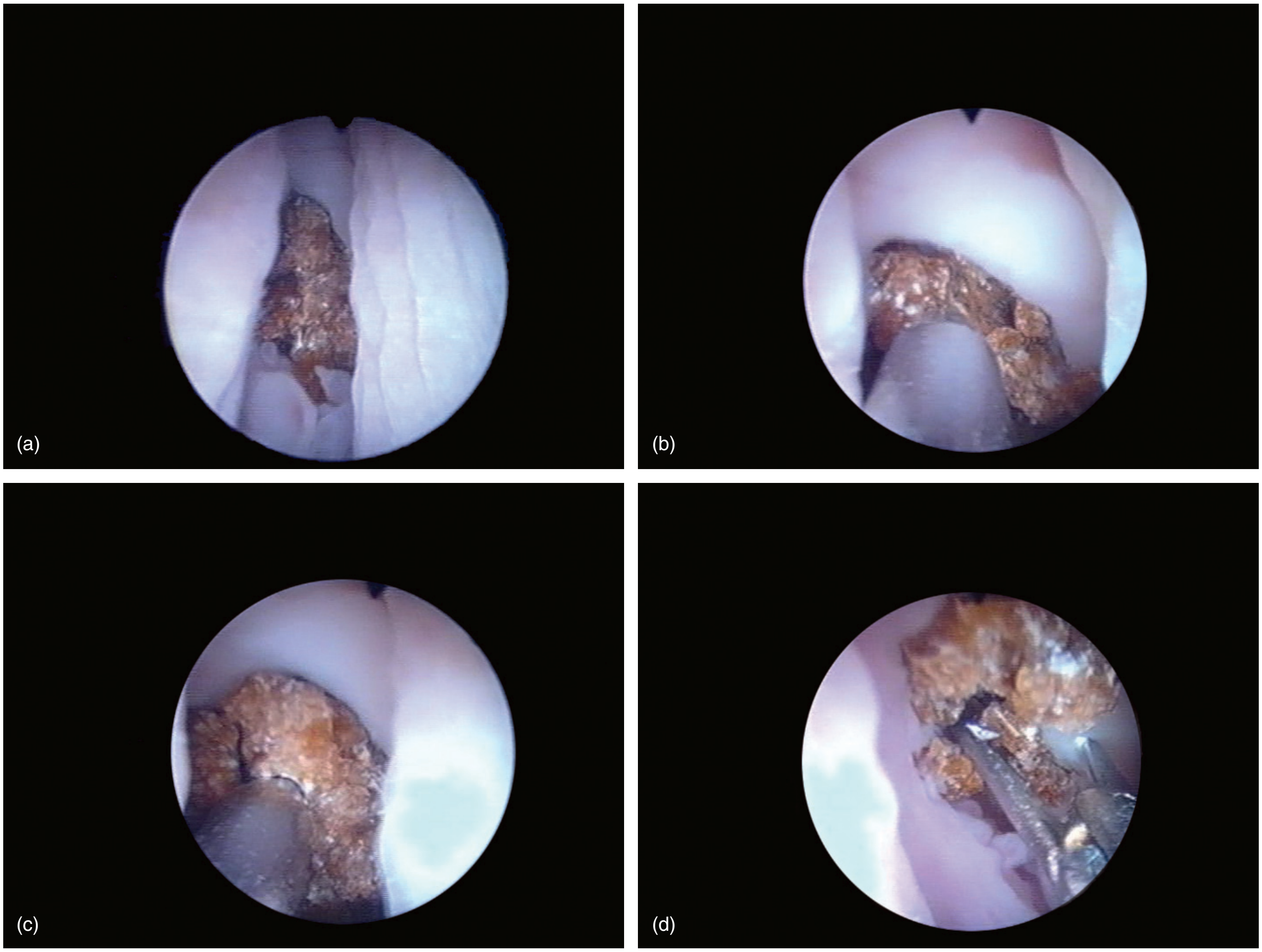


FIGURE 6.22 Stone impacted in a female urethra (a), *in situ* ballistic fragmentation (b, c), and extraction using forceps (d).

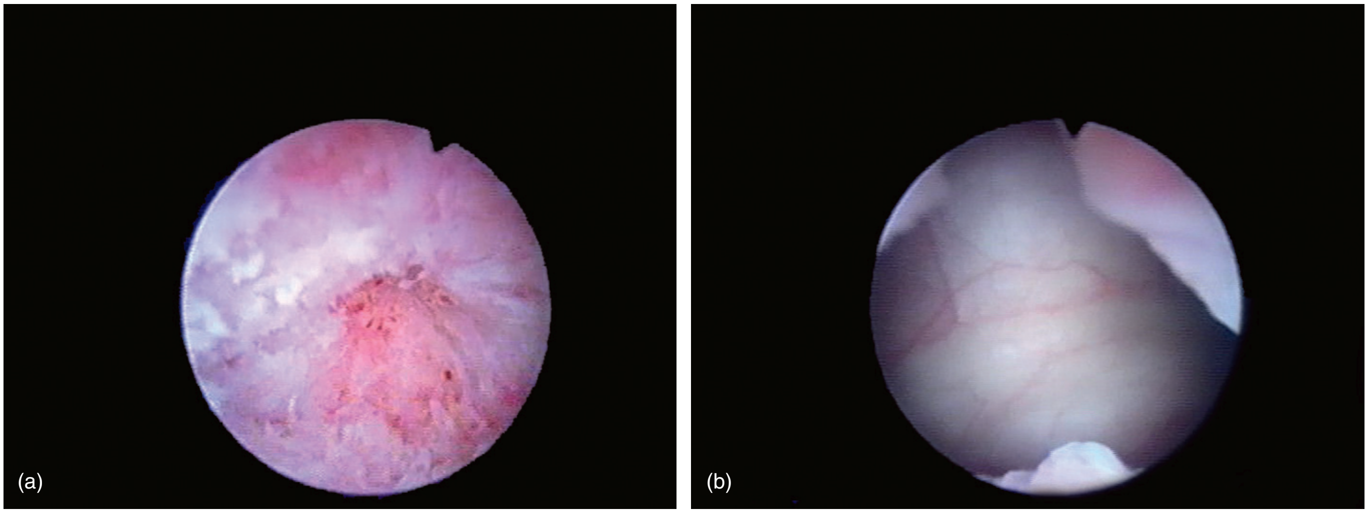


FIGURE 6.23 "Stone-free" aspect of the urethra (a) and of the bladder neck (b) at the end of the intervention.

6.3 URETHRAL FOREIGN BODIES

6.3.1 Generalities

Urethral foreign bodies represent a rare pathological entity that raises a series of diagnostic and therapeutic problems. The urethra represents the gate of entry for these bodies into the urinary apparatus, bodies that are described in the literature as so diverse that they defy imagination.

The immense majority of these foreign bodies reach the urethra retrogradely, after insertion through the urethral meatus. A case of anterograde urethral impaction of a duck bone was reported, which was ingested and migrated into the urinary apparatus through an entero-vesical fistula (Wykes and Barker, 1978).

Frequently, insertion of these foreign bodies is associated with psychiatric disorders, intoxications, or (auto) erotic circumstances (Geavlete et al., 2008; Mitterberger et al., 2009). A review of the literature in English between 1755 and 1999 identifies 800 cases of foreign bodies at the urogenital level, most of them inserted with a sexual purpose (van Ophoven and deKernion, 2000).

Among the urethral foreign bodies that have been identified we would mention pens, keys, electrical wires, candles, fragments of bottles or mirrors, needles, metallic rods, peanut shells, fish bones, brushes for cleaning bottles, necklaces, knife handles, etc. (van Ophoven and deKernion, 2000; Mitterberger et al., 2009; Kuwada et al., 2009; Hwang et al., 2010). The insertion of strange objects was described in a series of cases, among which were coyote ribs, decapitated snakes, or razor blades (Geyermann, 1937; Woodside and Bergreen, 1976). The reasons provided by the patients for inserting these objects included masturbation (in most cases), urethral dilation for a facile urination (Woodside and Bergreen, 1976), sealing of the meatus with chewing gum or candle wax for contraceptive purposes (Fister, 1934), control of incontinence with plastic pieces (Fig. 6.24), etc.

An important psychiatric aspect exists in these patients, which must be recognized and treated (Multescu et al., 2008). In some cases, patients insert these bodies with the intention of hurting themselves, as part of "autodestructive" behavior. These patients may even attempt suicide, and for this reason correction of their psychiatric problems represents an emergency (Wise, 1982; Boscolo-Berto et al., 2010).

There is a category of patients who present to the doctor with live organisms in the urethra, which have migrated during bathing in rivers and lakes, especially while urinating under water. Leeches and an urinophil Amazonian fish called Candiru (*Vandellia cirrhosa*) belong to this category (Pellegrin, 1909a, b; Ghosh, 1933; Herman, 1973). Finally, transurethral administration of cocaine by drug abusers has been reported (Mahler et al., 1988).

Another category is represented by foreign bodies iatrogenically introduced or retained in the urethra. These may be suture threads, unresorbed or migrated into the urethra (Fig. 6.25), fragments of surgical compresses or meshes (Figs 6.26 and 6.27), suture needles, portions of urethro-vesical catheters, or JJ stents, etc. (Mischianu et al., 2007; Mogorovich et al., 2009).

Sometimes medical materials (such as fragments of Foley catheters) may be retained in the urethra due to psychiatric disorders of the patients, who cut them while temporarily unsupervised.

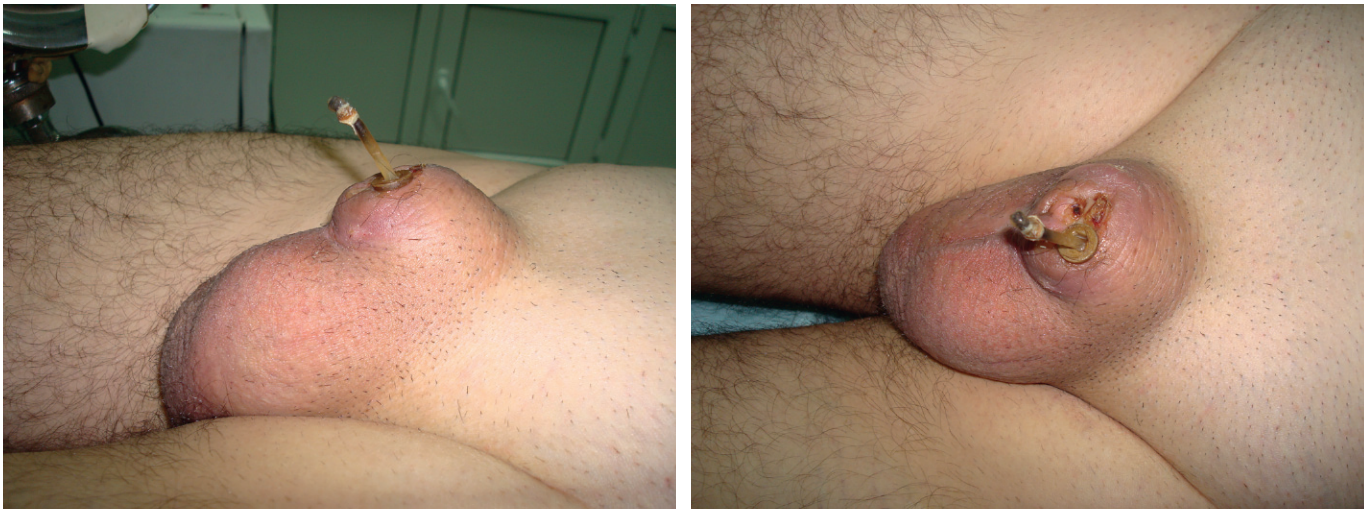


FIGURE 6.24 **Plastic piece inserted into the urethra with the declared purpose of "control of incontinence."**

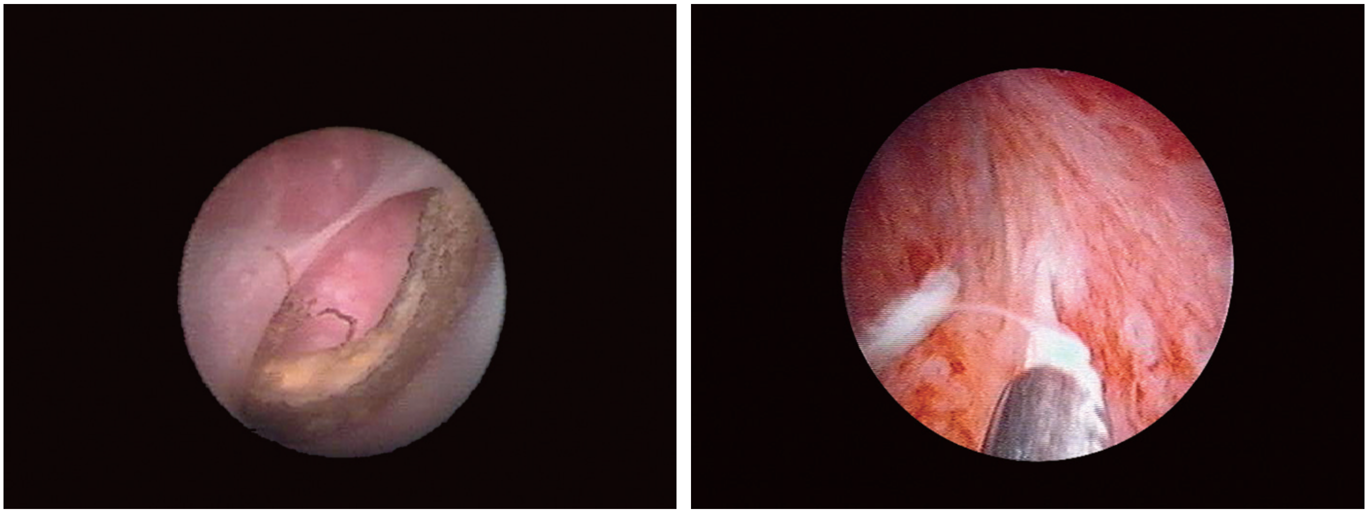


FIGURE 6.25 Suture threads, unresorbed or migrated into the urethra.

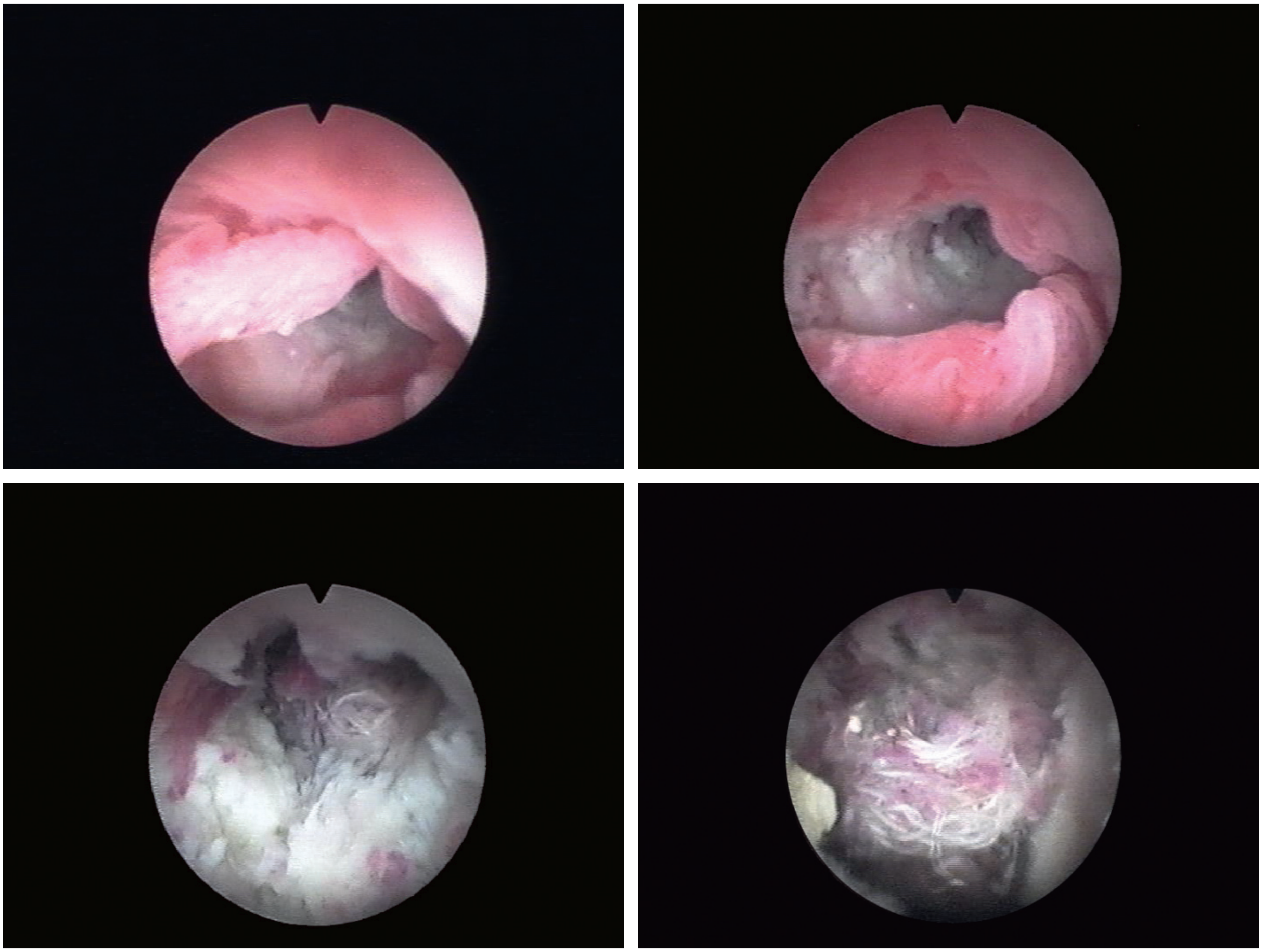


FIGURE 6.26 Surgical mesh in the prostatic cavity.

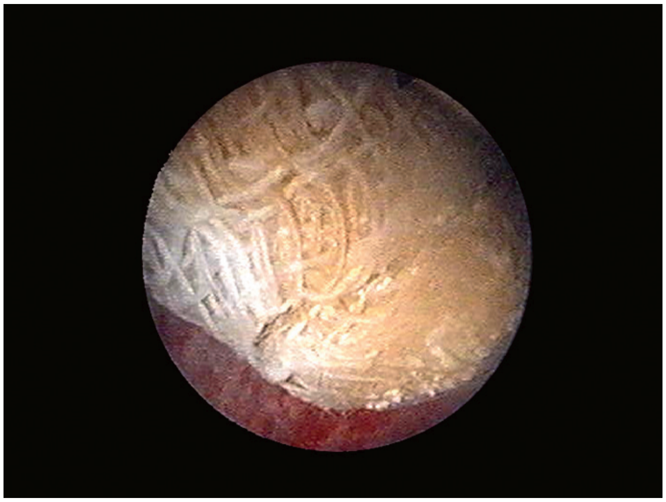


FIGURE 6.27 **Calcified surgical mesh in the urethra.**

Most of these insertions are done by adults, but pediatric cases have also been reported (Kuwada et al., 2009). In such cases psychiatric disorders are often associated, frequently triggered by lack of affection. The association of psychiatric disorders, equivocal data from radiologic examinations, as well as lack of recognizing iatrogenic causes, frequently make the diagnosis of this disease difficult (Hwang et al., 2010).

6.3.2 Indications

Urethral foreign bodies may be extracted by endoscopy or by open surgery. It is currently considered that a minimally invasive approach is the best method for curing this disease (Boscolo-Berto et al., 2010).

The potential limitations are represented only by the size of the foreign bodies, voluminous ones being difficult to extract through a narrow channel such as the urethra. However, large-scale use of lasers has transformed this problem into a relative one. Thus, the Ho:YAG laser has proven to be efficient in fragmenting a wide variety of foreign bodies (latex urethro-vesical catheters, urethral stents, metal guidewires, wood, steel, graphite, nylon, etc.). The only failures have been recorded with silicone catheters or copper wires (Bedke et al., 2010).

If, during the extraction maneuver, potentially severe additional lesions are produced, the intervention is stopped and a new approach is considered, or it is converted to open surgery.

6.3.3 Techniques

6.3.3.1 Patient Positioning

Interventions for extraction of these foreign bodies are performed with the patient in the lithotomy position, draped with sterile fields.

6.3.3.2 Anesthesia

The intervention may be performed under local, locoregional, or general anesthesia. The anesthetic requirements generally do not exceed those necessary for endoscopic treatment of urethral lithiasis. However, the frequent association of psychiatric disorders may warrant general anesthesia.

6.3.3.3 Extraction of Foreign Bodies

The approach to urethral foreign bodies is performed using a standard cystoscope, and small stones can be extracted in whole (Fig. 6.28). Voluminous or calcified foreign bodies may require processing before evacuation (laser or ballistic fragmentation, lithotripsy of the lithiasic shell, etc.) (Bedke et al., 2010) (Figs 6.29 and 6.30).

Due to the fact that the urethra provides limited space for maneuver, if possible, the foreign body is pushed upward into the bladder and is processed (Fig. 6.31). This maneuver can be performed especially in case of foreign bodies located in the posterior urethra.

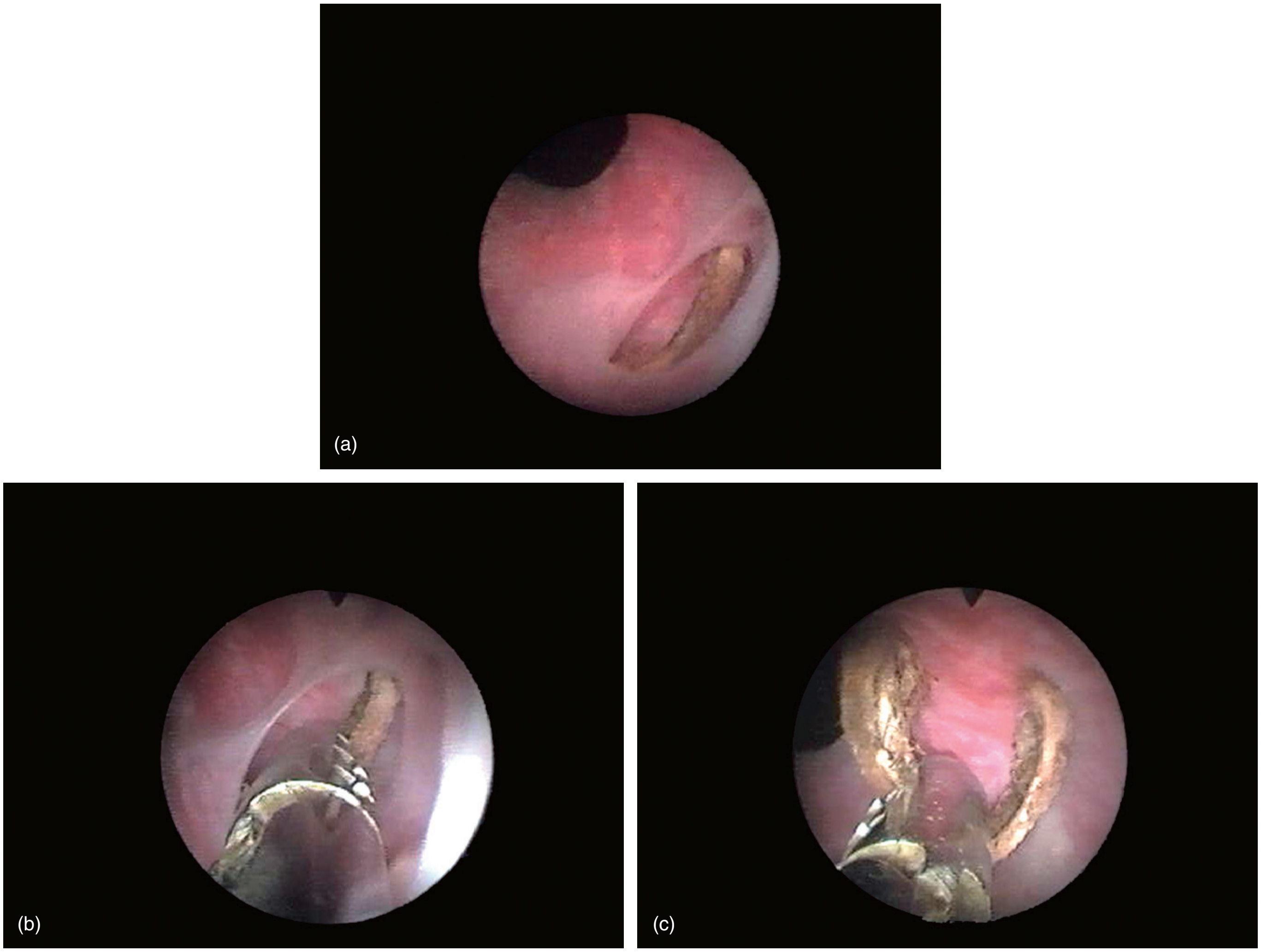


FIGURE 6.28 **Suture thread migrated into the urethra (a), extracted with forceps (b, c).**

If use of more robust forceps is necessary, right working channel cystoscopes may be used.

Occurrence of additional vesico-urethral lesions must be avoided during extraction of foreign bodies. Objects with the potential to produce perforations (needles, threads, metallic rods, etc.) can be partially introduced into the sheath of the cystoscope and maintained in this position during extraction, in order to minimize contact with the urethral walls. A particular situation is represented by foreign bodies located in the urethral wall or in the operated prostatic cavity (Fig. 6.32). In these patients, resection or incision of the tissue is necessary for exposing the bodies (Fig. 6.33), followed by their extraction (Figs 6.34–6.36).

A particular situation of urethral foreign bodies is represented by intraurethral strands of hair that can be detected after urethroplasties with a cutaneous graft on which pilous follicles are still present and viable (Beiko et al., 2011). Stones and calcifications can develop on these strands of hair (Fig. 6.37) (Kaneko et al., 2008).

After lithotripsy of any eventual stones, either chemical depilation of the urethra (Fig. 6.38) or laser destruction of the pilous follicles is performed (Kaneko et al., 2008; Beiko et al., 2011). Chemical depilation, and sometimes laser destruction, may require multiple sessions.

6.3.3.4 *Cystoscopy*

It is mandatory to perform cystoscopy at the end of the procedure in order to ensure a complete check-up, with identification of any possible urethral or intravesical lesions produced by the foreign body or even by the extraction maneuvers.

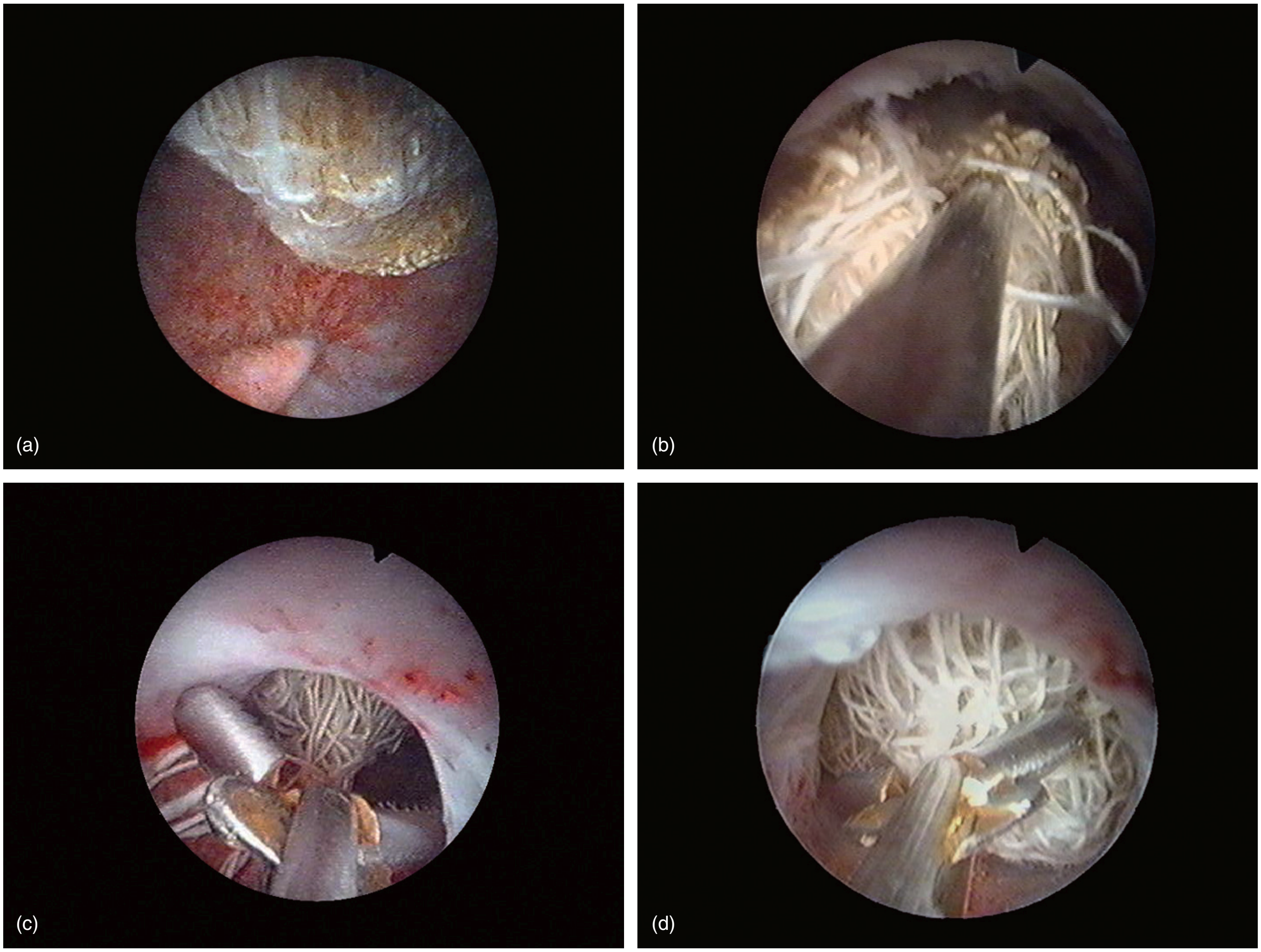
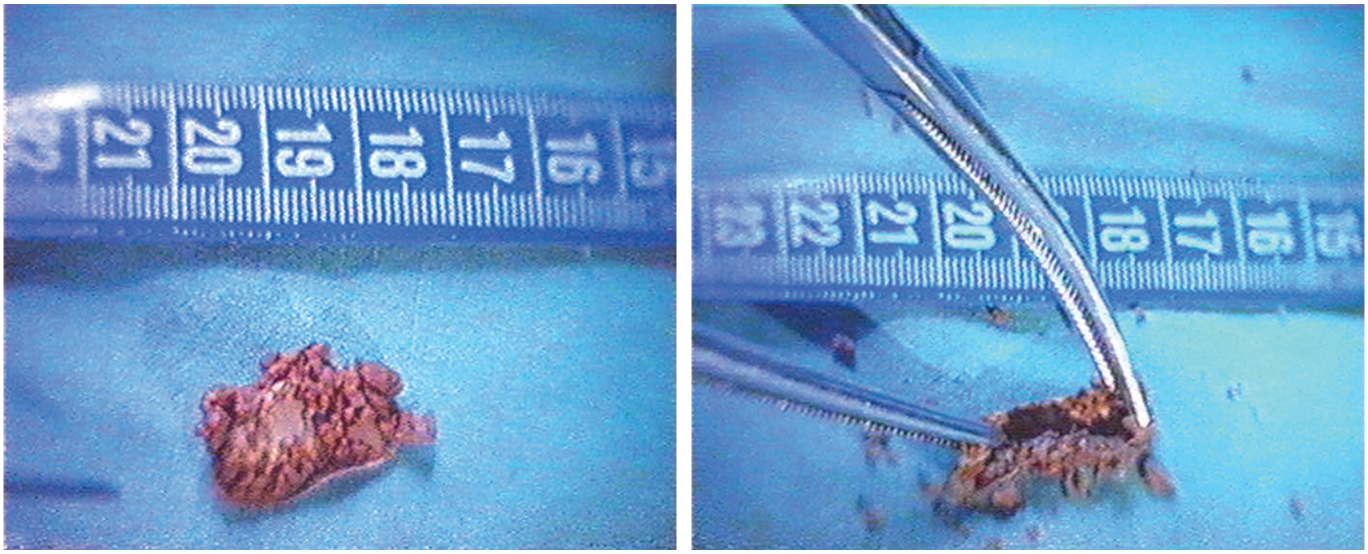


FIGURE 6.29 **Calcified surgical mesh in the prostatic cavity (a), ballistic fragmentation (b), and extraction using forceps (c, d).**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23 22 21 20 18 17 16 15

FIGURE 6.30 **Postoperative aspect of the calcified surgical mesh endoscopically extracted.**

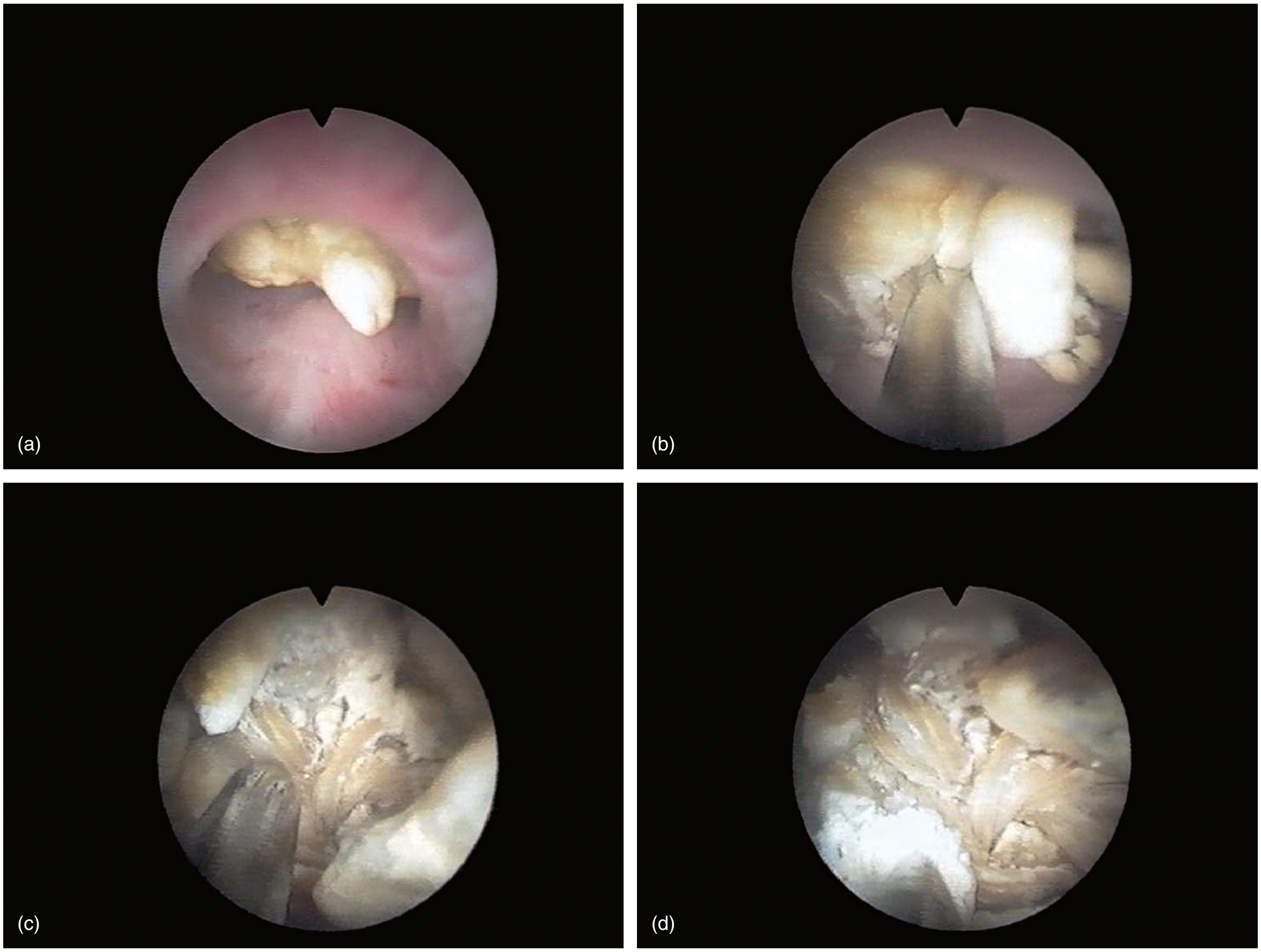

FIGURE 6.31 Candle in the bulbar urethra (a), endoscopically pushed upward into the bladder and fragmented (b–d).

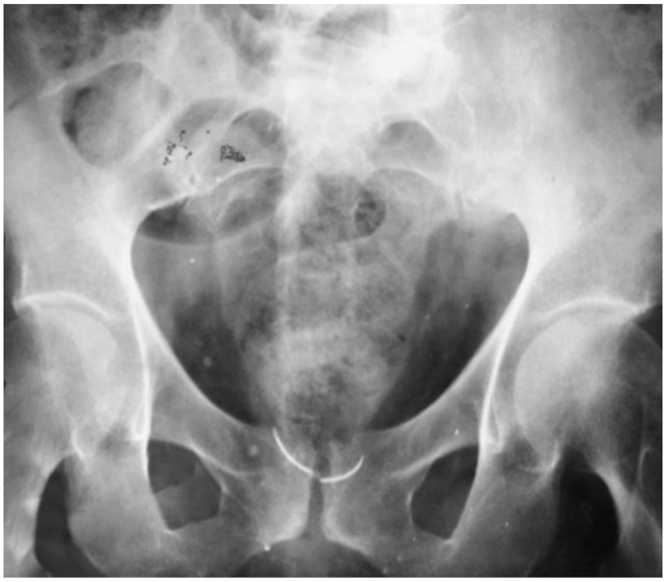

FIGURE 6.32 Fragments of a remaining suture needle in the wall of the prostatic cavity following transvesical adenomectomy.

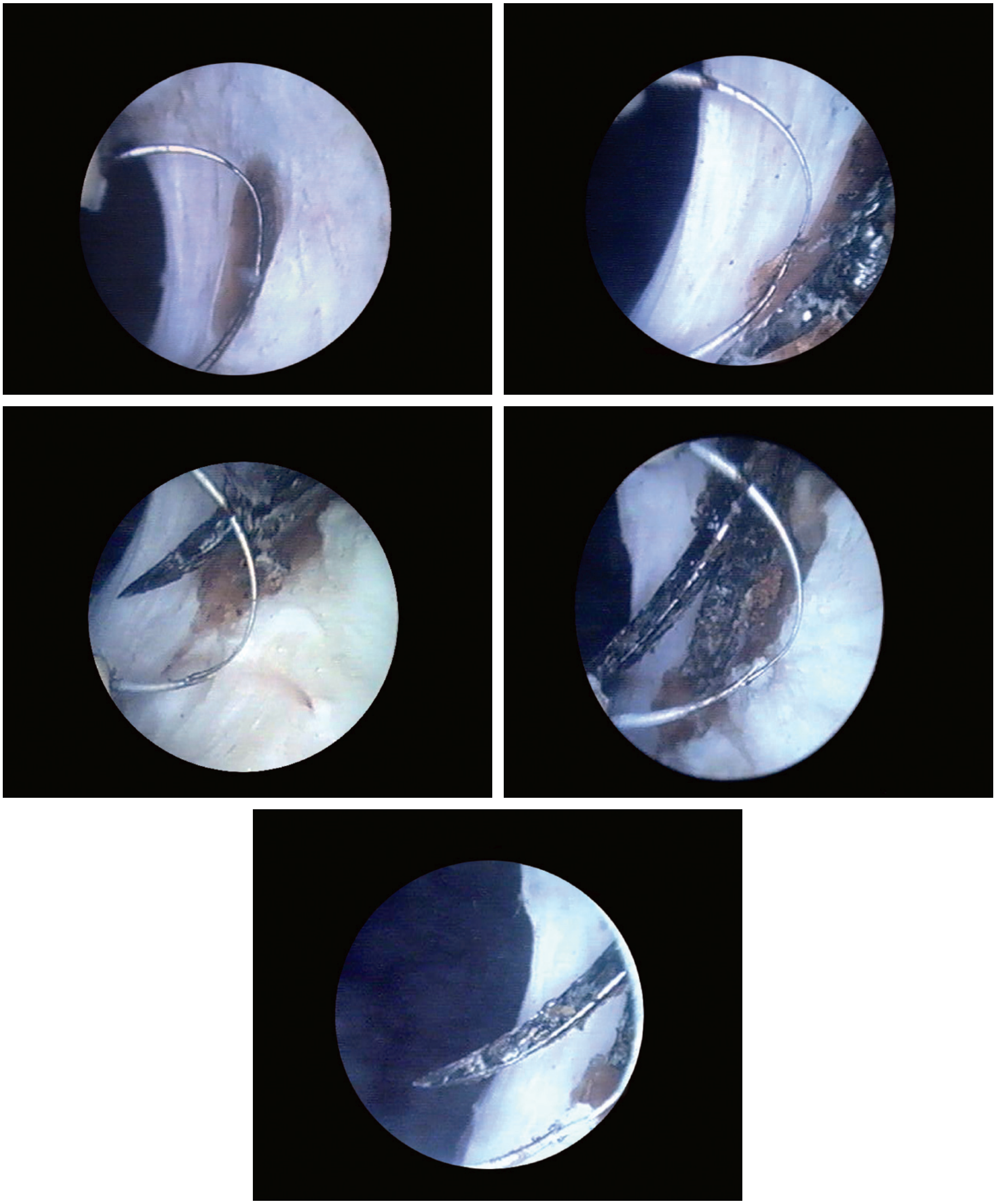

FIGURE 6.33 **Transurethral resection of the wall of the prostatic cavity, releasing the first fragment of the needle.**

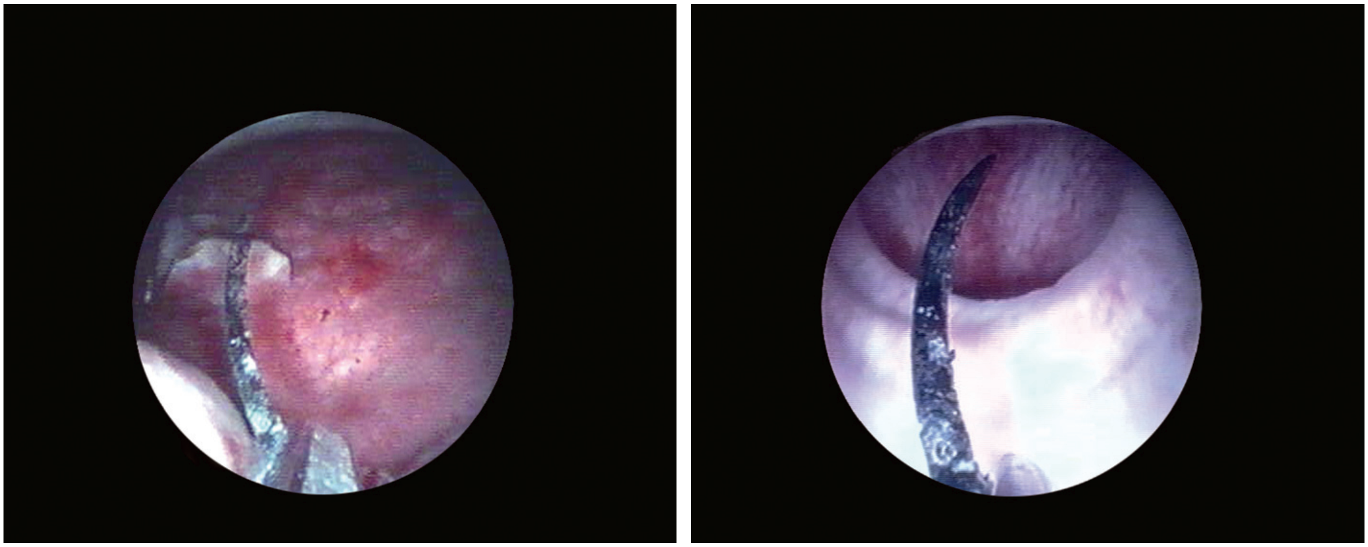

FIGURE 6.34 Extraction of the first fragment of the needle using tweezers.

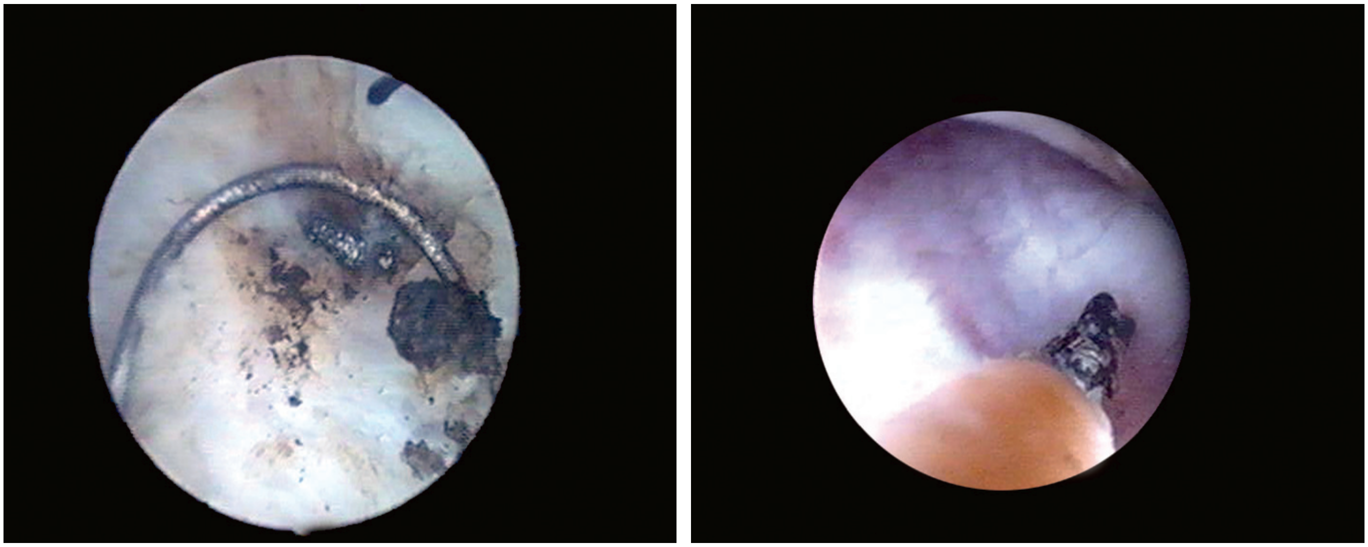

FIGURE 6.35 Extraction of the second fragment of the suture needle.

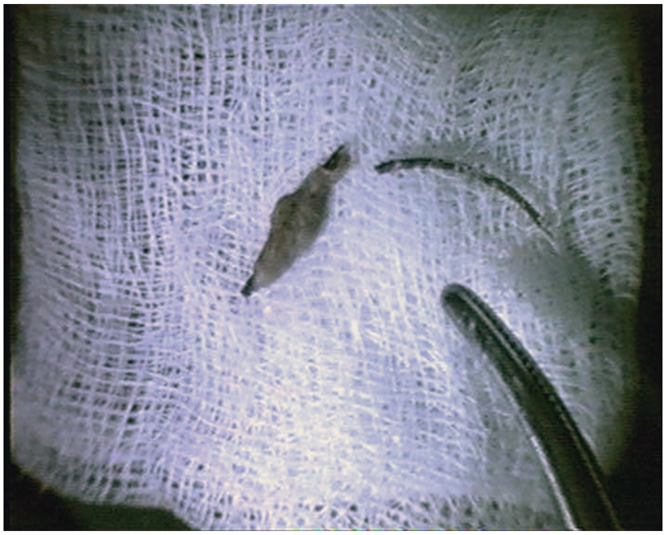

FIGURE 6.36 Aspect after extraction of the fractured needle.

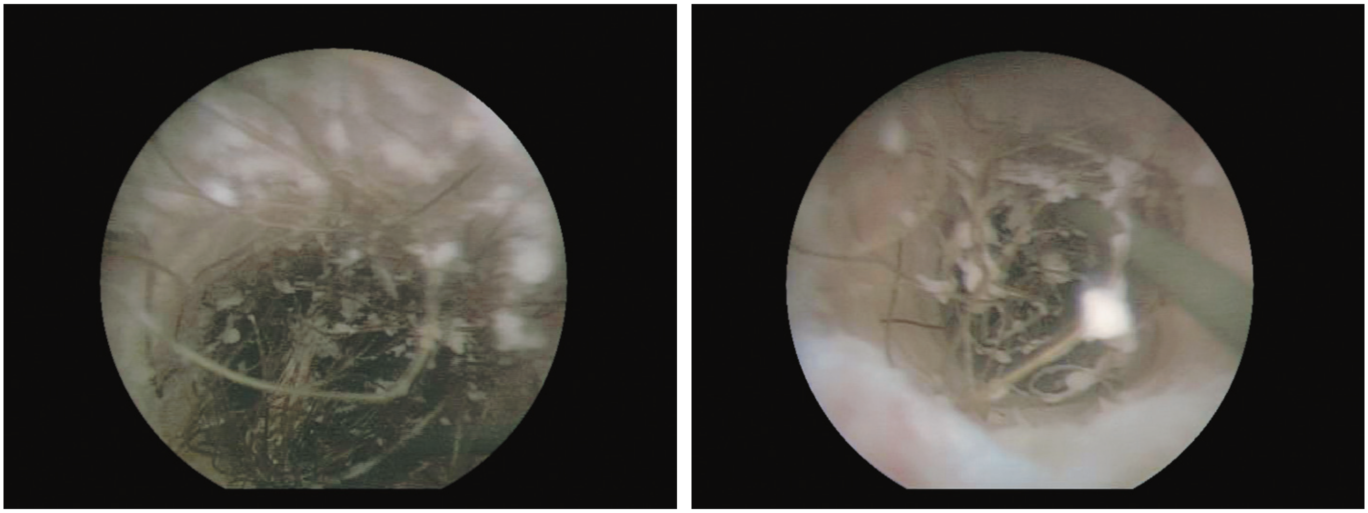

FIGURE 6.37 Intraurethral strands of hair.

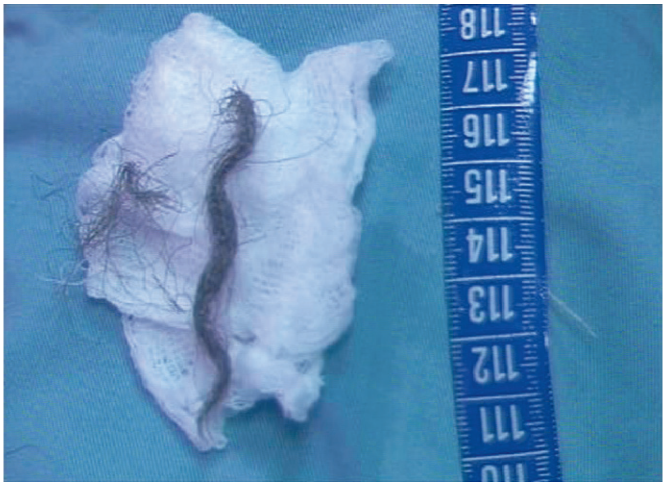

FIGURE 6.38 Aspect of intraurethral strands of hair extracted by chemical depilation.

6.3.4 Complications

A series of complications may be determined by insertion of foreign bodies into the urethra: lesions or perforations of the urethra, bladder, or even neighboring organs, urethrorrhagia, necrosis of the penis, septic complications, some of which may be severe (urinary infections, periurethral abscesses, Fournier gangrene, urosepsis, etc.) (Hwang et al., 2010).

The prolonged evolution of unrecognized foreign bodies may also lead to other serious complications, from migration into the retroperitoneum (Cury et al., 2006) to kidney failure (Jacobs et al., 2009), or even death (Berveiller et al., 2010).

These foreign bodies may, over time, lead to the appearance of urethral strictures, fistulas, or they may calcify, complicating their minimally invasive resolution (Rahman et al., 2010).

6.3.5 Results

Technological progress has made it possible to successfully cure this pathological entity, which is rare, but which raises management problems and which frequently requires participation of an experienced endourologist and application of an ingenious and innovative technique. The efficacy of endoscopic techniques varies between 33% and 100% (Mischianu et al., 2007; Mogorovich et al., 2009; Kuwada et al., 2009; Mitterberger et al., 2009; Bedke et al., 2010; Boscolo-Berto et al., 2010), the main determining factors being the size of the foreign bodies, the severity of the associated inflammatory process (van Ophoven and deKernion, 2000) and, probably, the technological endowment of the respective urology department and its experience in endourology.

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CHAPTER

7

Endoscopic Treatment of Urethral Tumors

Petrişor Geavlete, Răzvan Mulţescu, Mihai Drăguţescu, Dragoş Georgescu, Bogdan Geavlete

7.1 BENIGN URETHRAL TUMORS

7.1.1 Generalities

The generic term urethral benign tumor includes a heterogeneous group of lesions, which have diverse characteristics and evolution.

Depending on the histological type, they can be classified into:

- Epithelial or mixed tumors
  - inverted papillomas
  - fibroepithelial polyps
  - papillomas
- Mesenchymal tumors
  - hemangiomas
  - rhabdomiomas
  - leiomyomas
  - fibromas
- Inflammatory pseudotumors
  - false polyps

They can be located both in the anterior and posterior segments of the urethra.

In this section we will also describe condylomas, or pseudotumoral viral lesions. Urethral condylomas are caused by infection with the human papilloma virus, the majority of the urethral lesions being localized in the anterior segment (Segal et al., 1996). Only about 5% of papillomas are located in the proximal urethra and are usually accompanied by distal lesions (Zaak et al., 2003). These pseudotumors have the potential for malignant transformation into squamous epithelioma.

Urethral polyps may be true (Fig. 7.1) or false and can be found in both sexes. In men, the majority of these tumors are located in the prostatic urethra, although cases have been reported in the anterior part (Coleburn and Hensle, 1991; De Castro et al., 1993; Geavlete et al., 2001). True polyps are formed from conjunctive tissue that is covered by transitional epithelium; they can be congenital or acquired secondary to mechanical trauma of the urethral mucosa or to chronic inflammation (Abdullaev et al., 2009). These lesions, although very rare, have a higher incidence in male children and adolescents (Amrani et al., 1997). False polyps are inflammatory lesions created from granulation tissue and covered by urothelium (Figs 7.2 and 7.3). It is believed that these lesions represent the initial stage in the development of acquired fibroepithelial polyps (Abdullaev et al., 2009). Villous polyps are a rare variety that occur mostly in adults in the fourth decade of life on the verumontanum or adjacent to this structure (Guate Ortiz et al., 1991).

Several cases of prostate utricle papillomas have been reported (Aliabadi et al., 1987), as well as benign prostatic hyperplasia that resembles polyps in the prostatic urethra of young patients (Harada et al., 1991). Inverted papillomas

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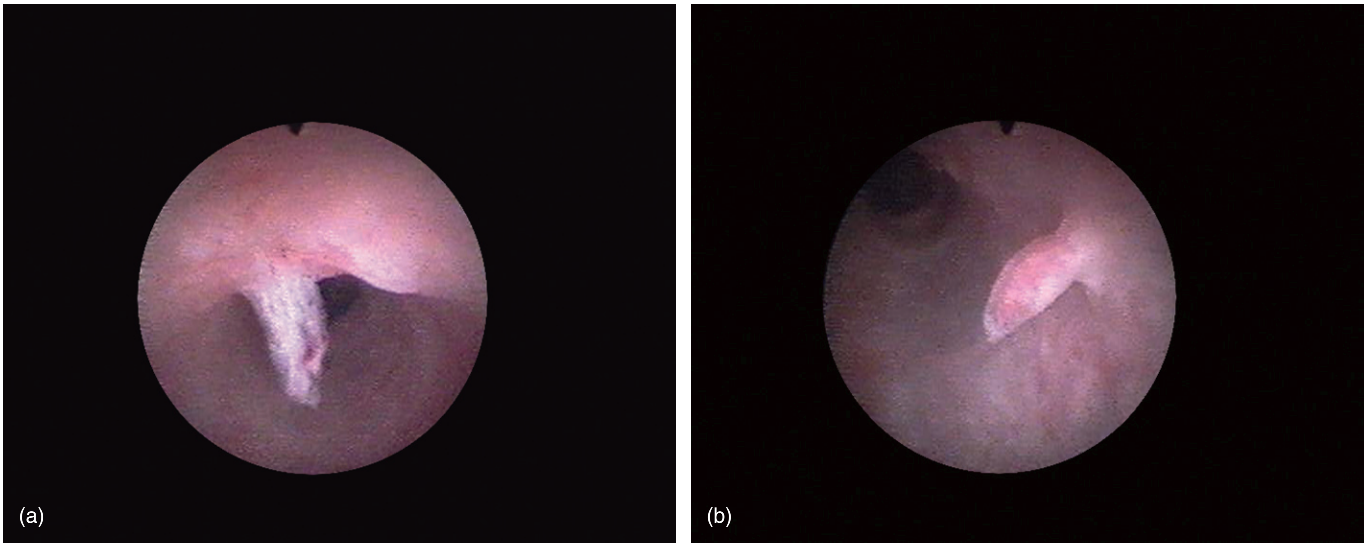

FIGURE 7.1 **Polypoid benign tumors located in the bulbar (a) or penile (b) urethra.**

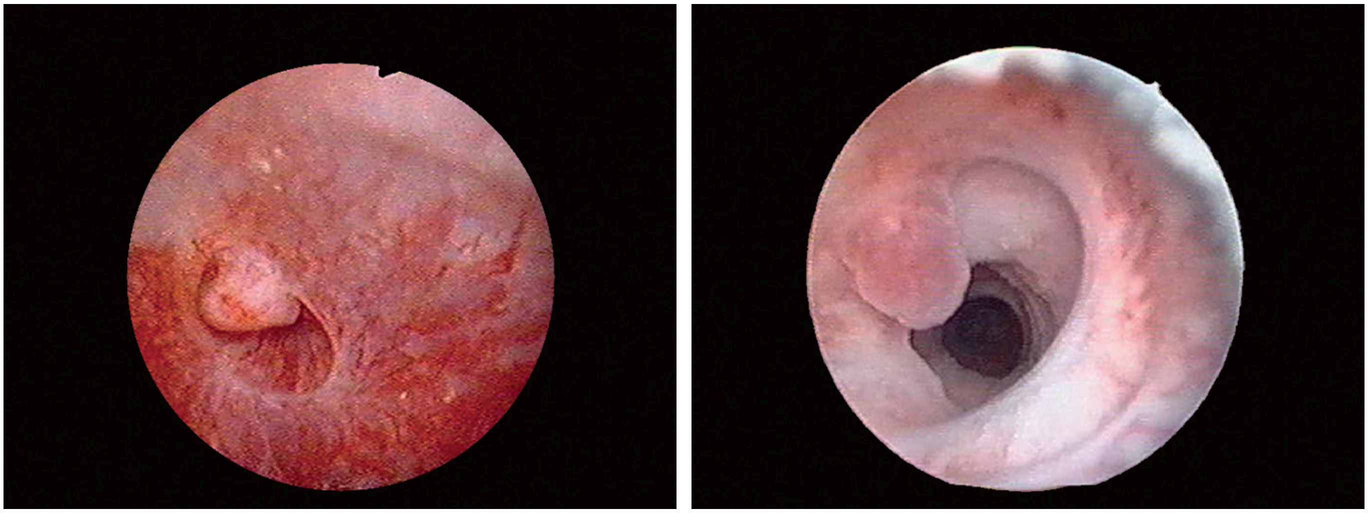

FIGURE 7.2 **False inflammatory polyps in a patient with operated urethral strictures.**

can be found either in the prostatic urethra (most commonly), or in the anterior urethra, and are typically covered with transitional epithelium that extends to the interior of the tumor (Ojea Calvo et al., 1993; Ochoa Undargarain et al., 2006).

The urethral caruncle is a benign urethral tumor that occurs mostly in postmenopausal women. Estrogen deficiency is the main cause for these lesions, their occurrence being exceptional in pre- or perimenopausal women. One case of male urethral caruncle was reported by Karthikeyan et al. (2002).

Mesenchymal tumors are represented by hemangiomas, fibromas, or myomas, which can also occur in both sexes (Pietruschka et al., 1978; Joshi and Beck, 2000). A review conducted by Segal and Kan on 107 cases of male urethral benign tumors treated over a period of 20 years revealed a predominance of viral papillomas (67.3%), followed by polyps (22.4%) and hemangiomas (10.3%) (Segal et al., 1996).

In women, urethral caruncles have a higher incidence, located at the external urethral meatus, on the inferior circumference (Usunova and Vladimirov, 2009).

7.1.2 Indications

The endoscopic approach of tumors has a dual role, both diagnostic and therapeutic (Amrani et al., 1997). The pathology examination is the only way to establish a correct diagnosis.

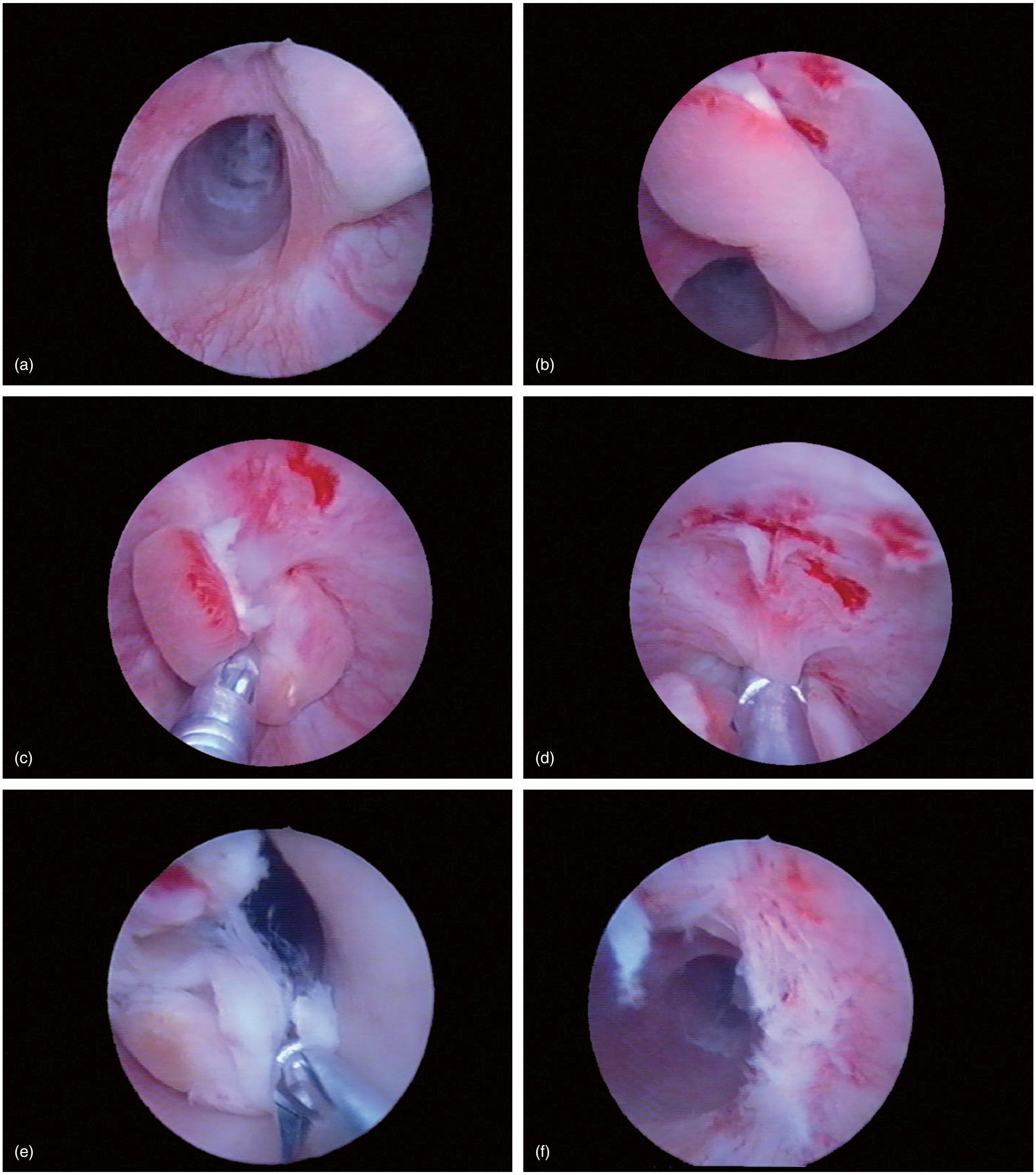

FIGURE 7.3 False (inflammatory) urethral polyp underlying a urethral stricture (a, b), from which a "cold-cup" biopsy is performed with a forceps (c–f).

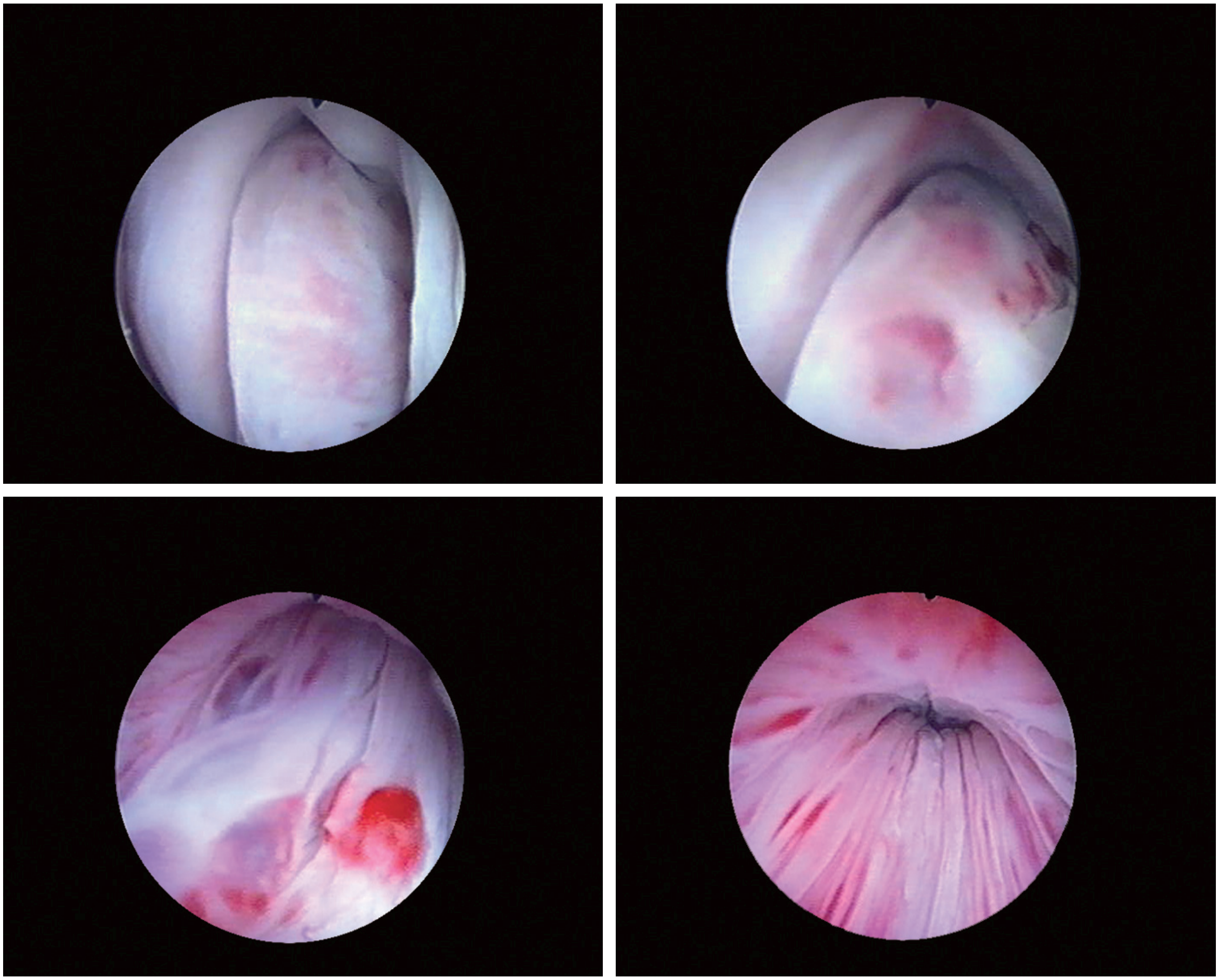

FIGURE 7.4 **Endoscopic exploration of the urethra in a patient with massive urethral caruncle.**

Unlike urethral malignant tumors, a significant proportion of benign urethral tumors can be treated by an endoscopic approach.

The treatment of choice for urethral caruncles (Fig. 7.4) is surgical excision or electrocauterization due to their distal position. Even though few cases require endoscopic resection, the first step in all patients is the endoscopic assessment of the urethra. Polypoid lesions are amendable by transurethral resection or laser excision (Gleason and Kramer, 1994; Gentle et al., 1996).

Treatment for hemangiomas is customized depending on the dimensions and location of the lesion. Thus, small and asymptomatic hemangiomas require only monitoring and may regress spontaneously. Medium-sized hemangiomas may be electrofulgurated (although this option is preferred only in the management of acute cases) or treated with Nd:YAG, argon, or KTP 532 nm lasers (Lauvetz et al., 1996; Geavlete and Nita, 2004). Massive hemangiomas require surgical excision followed by urethral reconstruction.

Urethral condylomas may also require an urethrocystoscopic approach. Around 20% of these conditions can be resolved exclusively by endoscopy (Rothauge et al., 1981; Schneede et al., 2001).

7.1.3 Techniques

7.1.3.1 Anesthesia

Treatment of benign urethral tumors is performed under regional anesthesia, local anesthesia with or without sedation, or, if necessary, general anesthesia.

7.1.3.2 *Patient Positioning*

The operation is performed in a classic lithotomy position, with the patient appropriately draped with sterile fields.

7.1.3.3 *Urethrocystoscopy*

The purpose of the initial urethrocystoscopy is to characterize the urethral tumors: number, position, appearance, and dimensions. The implantation area of any pediculated tumors is identified during this stage.

7.1.3.4 *Biopsy of the Tumor*

Biopsy is mandatory when the nature of the tumor is uncertain and can be achieved using a forceps (cold-cup) (Fig. 7.5). If the tumor ablation is performed by transurethral resection or laser excision, these methods also allow for the harvesting of tissue fragments for pathological examination.

7.1.3.5 *Tumor Ablation*

The ablation of the lesion can be achieved in various ways, depending on the type, position and size of the tumor, the energy sources available, etc.

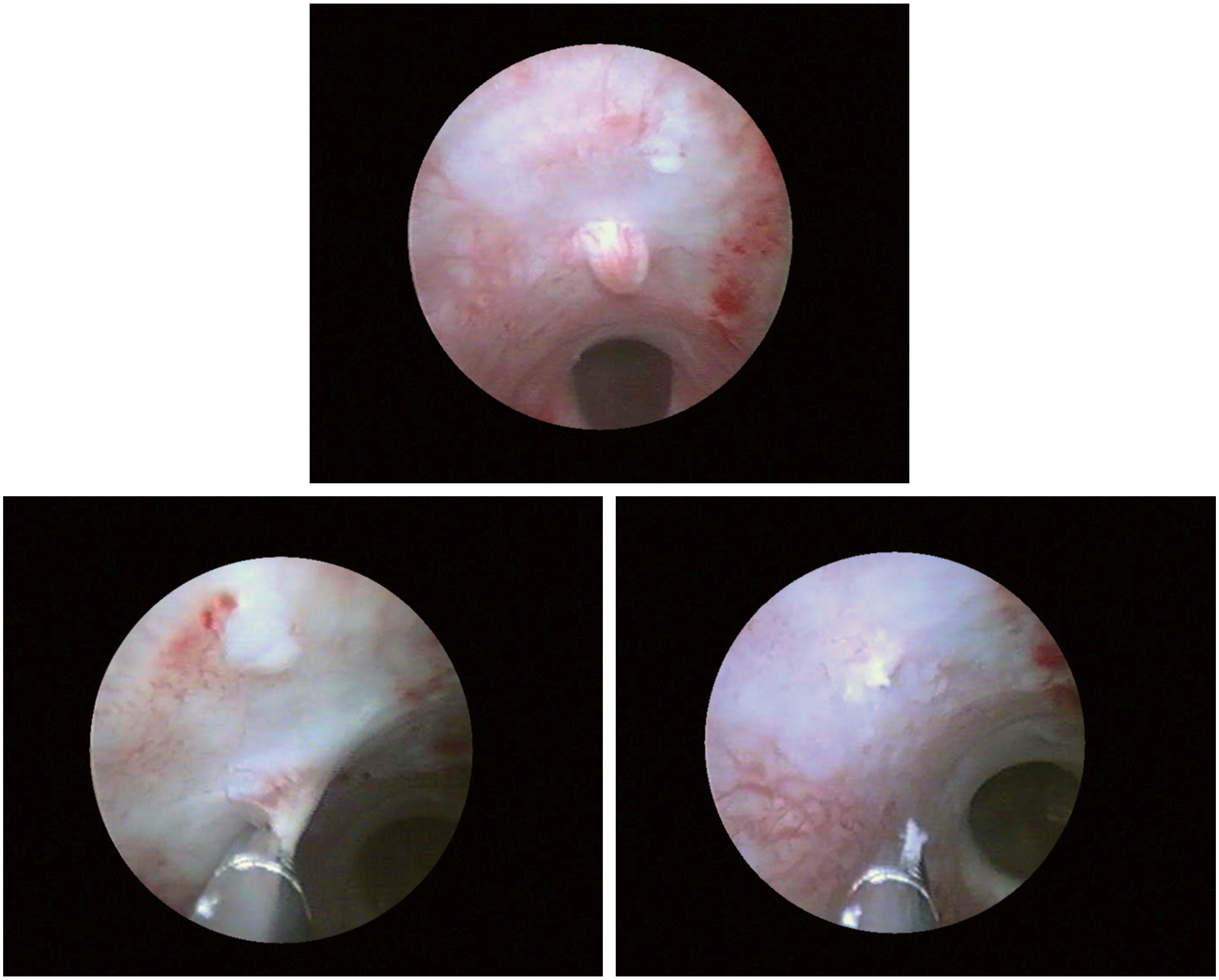

FIGURE 7.5 **"Cold-cup" biopsy of a urethral tumor.**

7.1.3.6 Transurethral Resection

Transurethral resection is used especially for the treatment of fibroepithelial polyps, inverted papillomas, fibromas, myomas, and other similar lesions (Zulian et al., 1982; Tokumitsu et al., 1992; Ojea Calvo et al., 1993; Tekou and Robert, 1999; Joshi and Beck, 2000; Isaac et al., 2006). The procedure can be done by cutting the base and extracting the entire tumor mass in case of small tumors. Progressive resection and extraction of the fragments (Figs 7.6–7.8) may be necessary in case of large tumors (sometimes reaching partly into the bladder). Transurethral resection of giant urethral tumors (up to 32 g) has been reported (Joshi and Beck, 2000). The final step is to clot the base of the tumor.

If the tumor is located in the prostatic urethra in a patient with benign prostatic hypertrophy, resection of the lesion may be accompanied by resection of the adenoma (Nozawa et al., 1996).

7.1.3.7 Electrofulguration and Electroexcision

This procedure is used for the treatment of urethral hemangiomas or polyps (Guate Ortiz et al., 1991). Destruction of the lesion with different types of electrodes (Bugbee, etc.) should be done until only healthy tissue remains (De Castro et al., 1993) (Fig. 7.9).

7.1.3.8 Vaporization and Laser Excision

Different types of lasers may be used Nd:YAG, Ho:YAG, argon, KTP 532 nm, etc. These energy sources allow fulguration or vaporization of benign tumors (especially for small tumors), or excision (for large tumors) (Lauvetz et al., 1996; Gentle et al., 1996; Chepurov et al., 2001). The base of the tumor is clotted at the end of the procedure.

7.1.3.9 Urethro-Vesical Catheterization

A urethro-vesical catheter is inserted for 24–48 h at the end of the procedure.

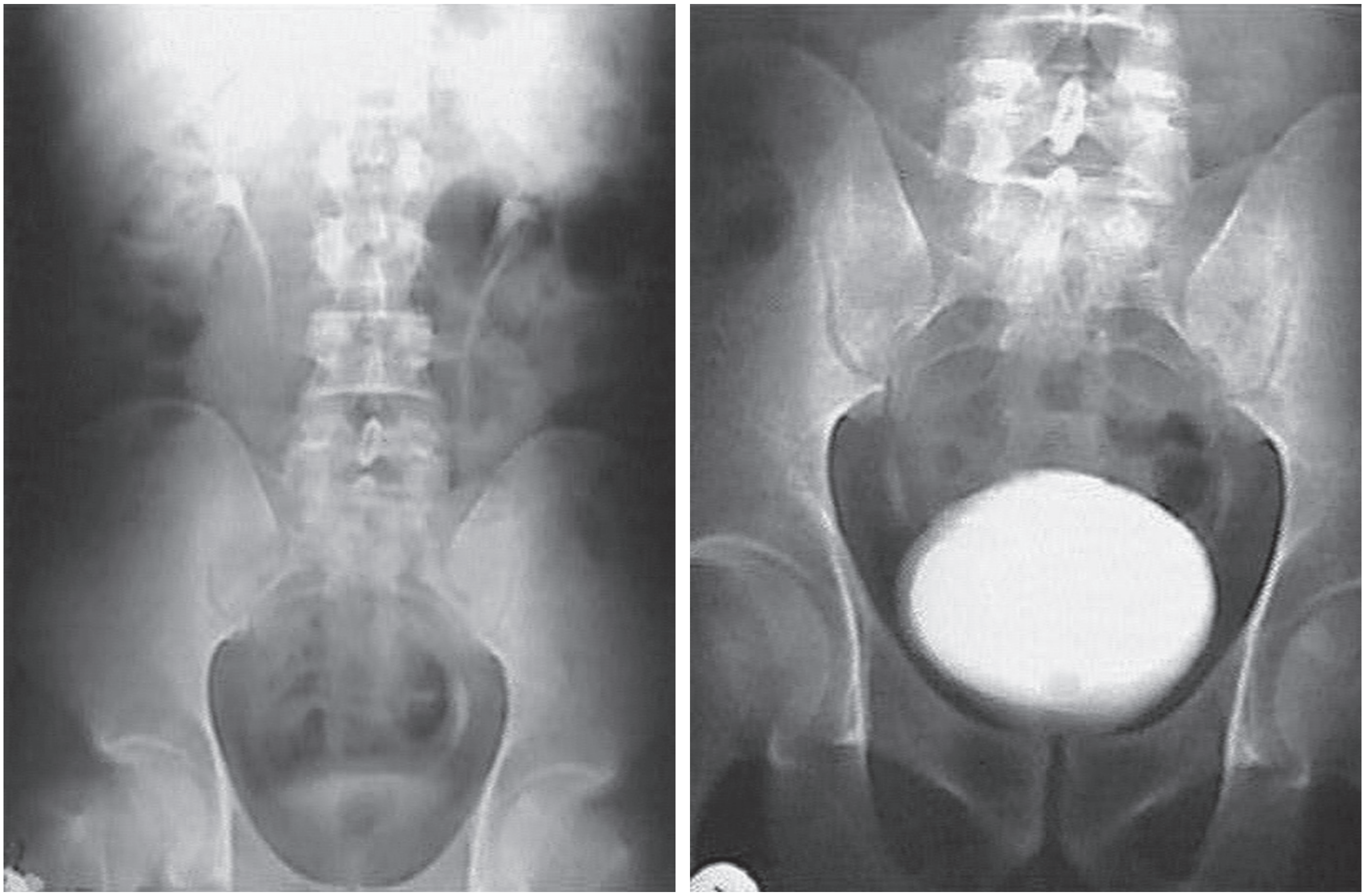

FIGURE 7.6 **Lacunary image near the neck of the urinary bladder produced by a giant fibroepithelial polyp that extends from the verumontanum.**

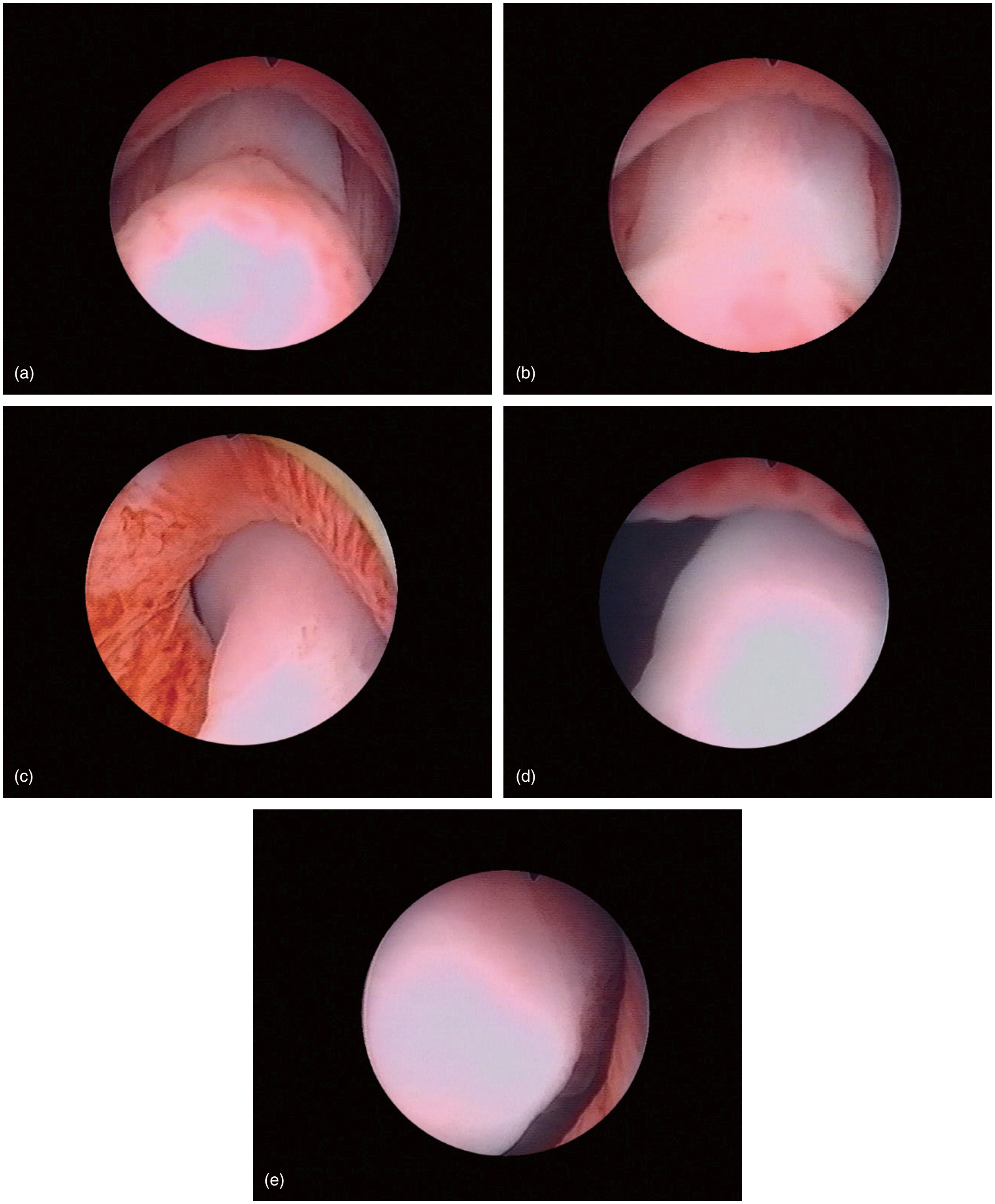

FIGURE 7.7 Endoscopic aspect of the same fibroepithelial polyp that starts in the verumontanum (a), occupies the prostatic urethra (b, c), and extends all the way to the bladder (d, e).

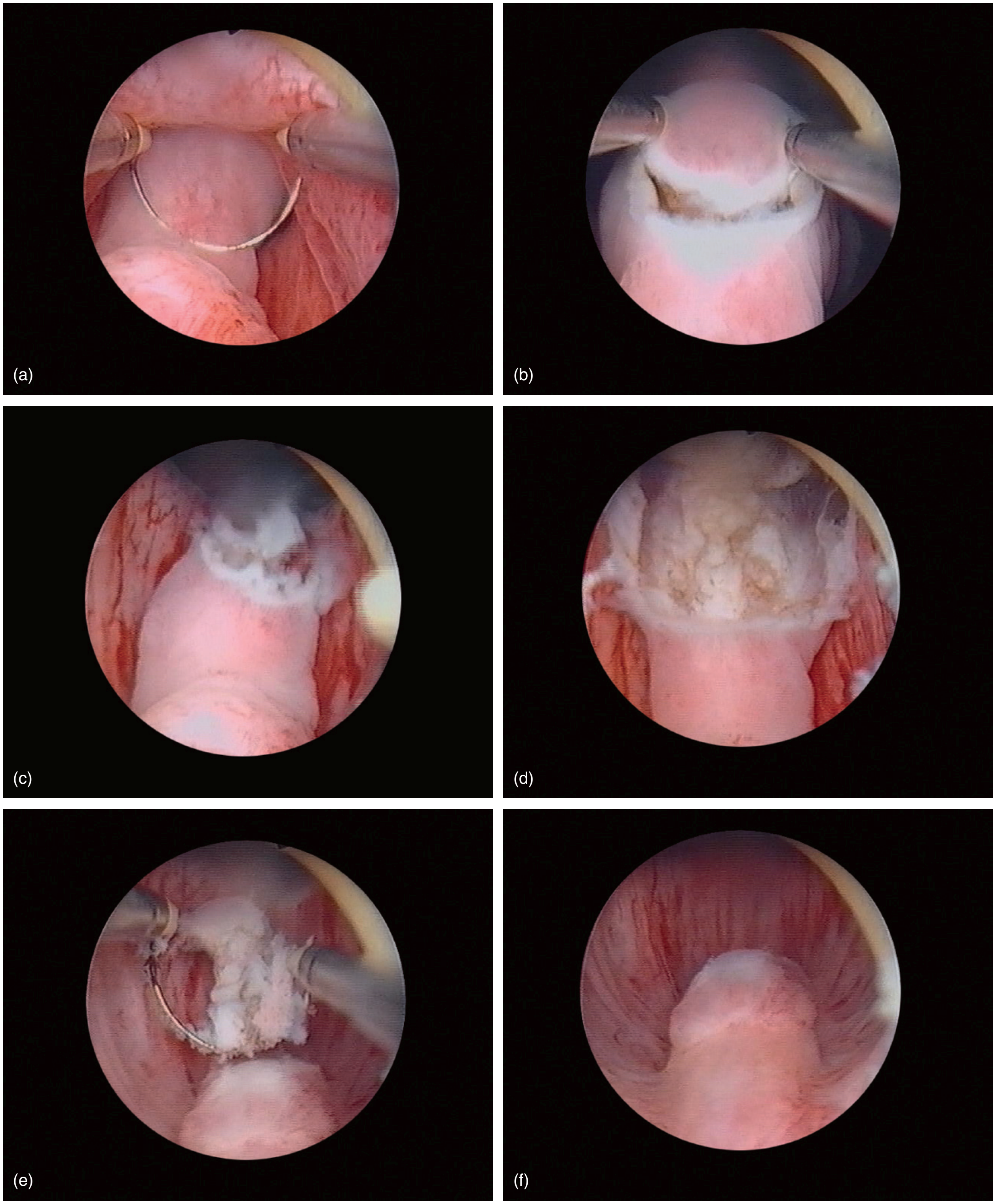

FIGURE 7.8 Transurethral resection of the fibroepithelial polyp (a) starting from its distal intravesical portion (b, c) and continuing with its urethral portion (d, e); the final step is to clot the base of the tumor (f).

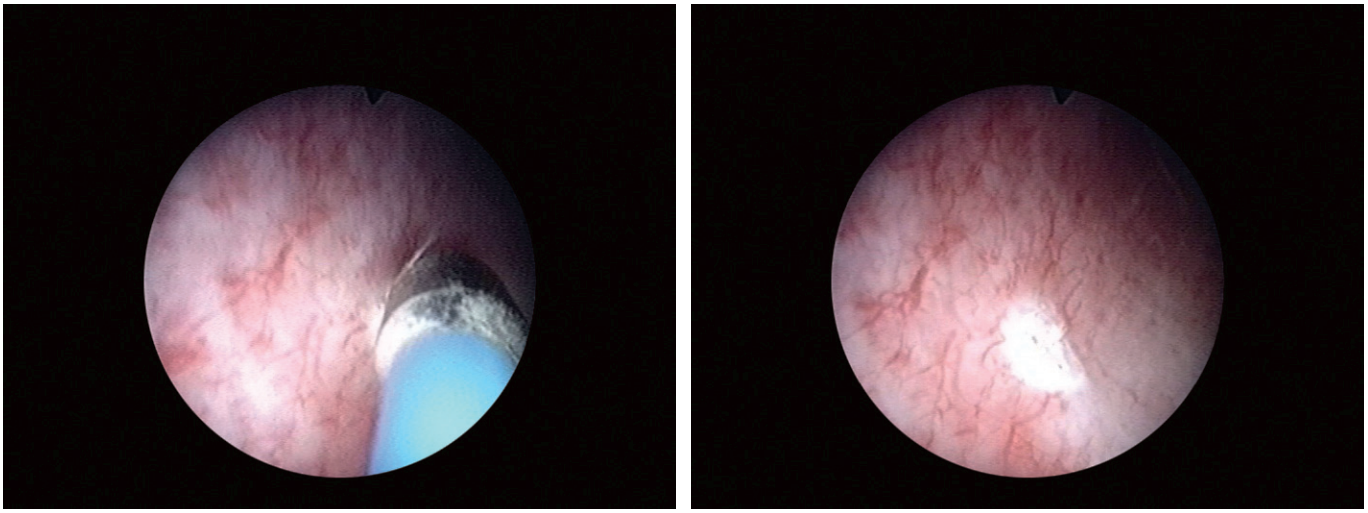

FIGURE 7.9 Electrofulguration of a small urethral fibroepithelial polyp by using a Bugbee electrode.

7.1.4 Complications

The complications associated with the endoscopic treatment of benign urethral tumors are nonspecific, and common to all types of endoscopic ablative urethral interventions. They include bleeding, infection, perforations, strictures, diverticula, and fistulas.

7.1.5 Results

Benign urethral tumors can be successfully treated by an endoscopic approach, regardless of the source of energy used. Electrical or laser fulguration of hemangiomas usually allows for their sustainable removal (Lauvetz et al., 1996; Geavlete and Nita, 2004). Technical failure of this procedure in the case of polyps has only been reported in exceptional cases, where open surgery was required, usually by a transvesical approach (Abdullaev et al., 2009). For this type of benign tumor, no recurrence or evolution toward malignancy has been reported (Gleason and Kramer, 1994; Isaac et al., 2006).

Regarding inverted papillomas, an analysis of the data reported in the literature showed a relapse rate of 3.85%. Furthermore, 1.55, 5.90, and 1.54% of cases were associated with other past, synchronous, or subsequent vesical malignant urothelial tumors, respectively (Cheng et al., 2005). For this reason, annual endoscopic follow-up is recommended after intervention for this type of tumor (Ochoa Undargarain et al., 2006).

Condylomas have a very high potential for recurrence, reaching up to almost 47%. This can be reduced to 21% when photodynamic diagnosis is used in combination with ablation using Nd:YAG laser (Zaak et al., 2003).

In our experience we have encountered urethral tumors that are not classified in the literature, such as cystic lesions. We performed an incision of the wall and evacuated the contents in these cases (Fig. 7.10).

7.2 MALIGNANT URETHRAL TUMORS

7.2.1 Generalities

Urethral cancer is a rare pathological entity, accounting for less than 1% of all malignant tumors (Eng et al., 2003). However, although about 2000 cases are reported in the literature, the actual incidence of malignant urethral tumors is considered to be underestimated. Malignant lesions of the urethra are primary or secondary tumors. Depending on the histological type, primary urethral tumors are classified into (Grigsby and Herr, 2000):

- transitional cell carcinoma (Fig. 7.11) – represents 10–25% of cases in women and 15% of cases in men, it originates in the urothelium in the proximal part of the urethra and is frequently seen in the prostatic urethra, representing 90% of the tumors at this level.

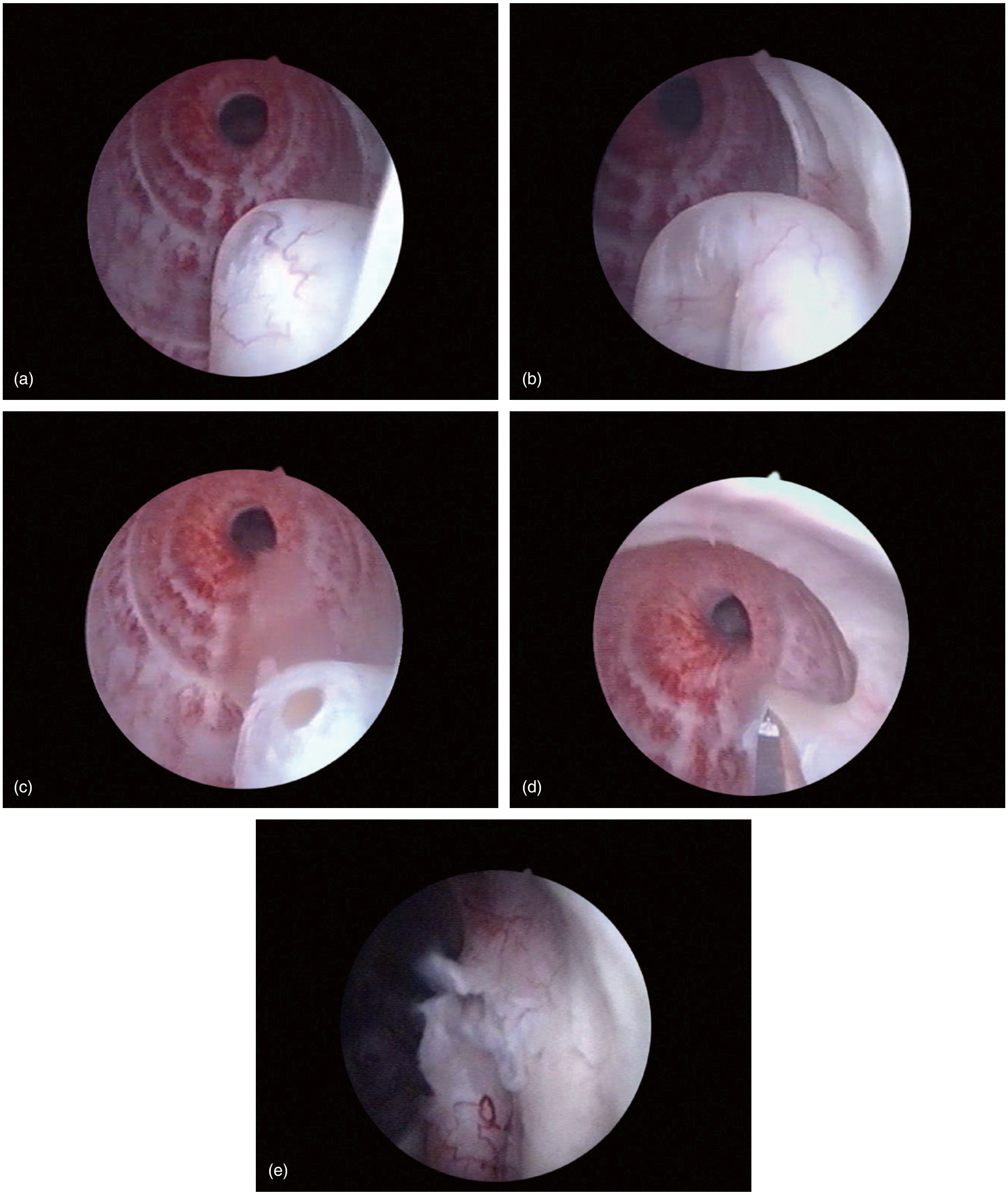

FIGURE 7.10 Cystic urethral tumor (a); a cold blade incision is performed and the content is drained (b–e).

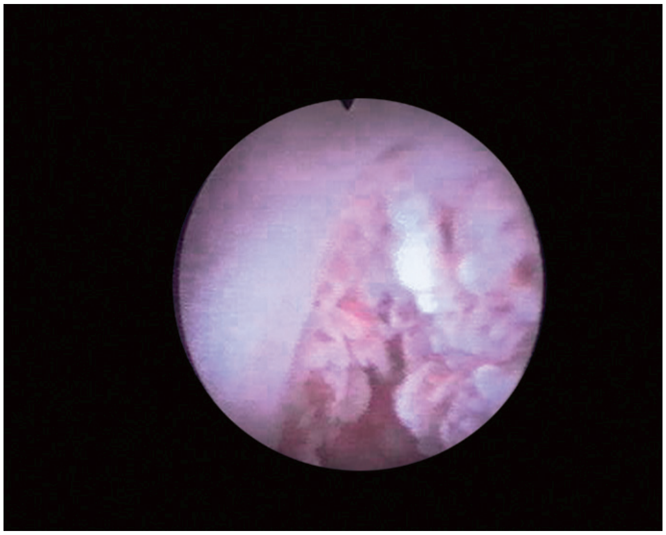

FIGURE 7.11 **Urothelial urethral tumor in a female.**

- squamous cell carcinoma – originates in the squamous epithelium in the distal urethra; it is the most common urethral malignancy, representing 80% of cases in men and 50–70% of cases in women; only 10% of the tumors in the prostatic urethra are of squamous type.
- adenocarcinoma – represents 10–25% of cases in women and 5% of cases in men, it occurs in areas with metaplasia or near the periurethral glands; it is the most common type of tumor developed inside urethral diverticula (Jimenez de León et al., 1989; Bakkali et al., 2002; Iborra et al., 2009).
- clear cell carcinoma – it is more common in women; over half of the cases are seen in the urethral diverticula (Miller and Karnes, 2008).
- melanoma – occurs in both sexes, especially in the distal urethra; it is an aggressive form of malignant urethral tumor (Filipkowski et al., 2009).
- other rare forms – small cell neuroendocrine type, lymphomas, and plasmacytomas (Gokce et al., 2008; Yoo et al., 2009; Muraoka et al., 2009).

The most common histological type in both sexes is the epidermoid squamous cell carcinoma, followed by urothelial carcinoma in males and adenocarcinoma in females (Avancès et al., 2009). Depending on the location, 60% of the male urethral tumors (Fig. 7.12) are located in the bulbomembranous segment, 30% in the penile segment, and only 10% are in the prostatic segment.

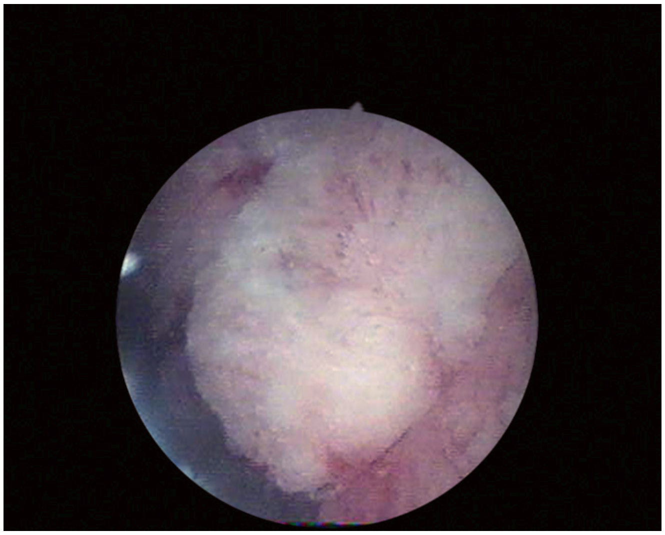

FIGURE 7.12 **Infiltrative urethral tumor in a male.**

The incidence of these tumors varies according to race (African-American males have twice the risk of developing urethral cancer compared with the white population, and 85% of urethral tumors appear in white females), gender (four times more common in females), and age (incidence is higher in the fifth or sixth decade of life in females and in the seventh decade in males) (Srinivas and Khan, 1987; Narayan and Konety, 1992; Terry et al., 1997; Swartz et al., 2006).

There are some controversies regarding the demographic data of these tumors, due to the small number of cases. Thus, Swartz et al. (2006) reported a greater incidence of urothelial tumors in the United States. According to his study, urethral malignant lesions are more common in African-Americans and, contrary to the data reported by Narayan, in males.

Among the factors incriminated in the etiology of these cancers in men are sexually transmitted diseases, exposure to various substances, such as arsenic, history of radiotherapy, the presence of bladder tumors, etc. (Gillitzer et al., 2008). A number of urothelial urethral tumors can be secondary to bladder tumors by dissemination of malignant cells through the urine (Figs 7.13–7.15).

The presence of leukoplakia, human papilloma virus infection, caruncle, urethral diverticula, etc. is related to the urethral occurrence of malignant tumors in the female population. About 5% of female urethral cancers occur inside diverticula (Rajan et al., 1993). An association between urethral strictures and urethral cancer has been described. One of the etiopathogenic hypotheses is represented by initiation of the malignant process due to chronic inflammation (Fig. 7.16).

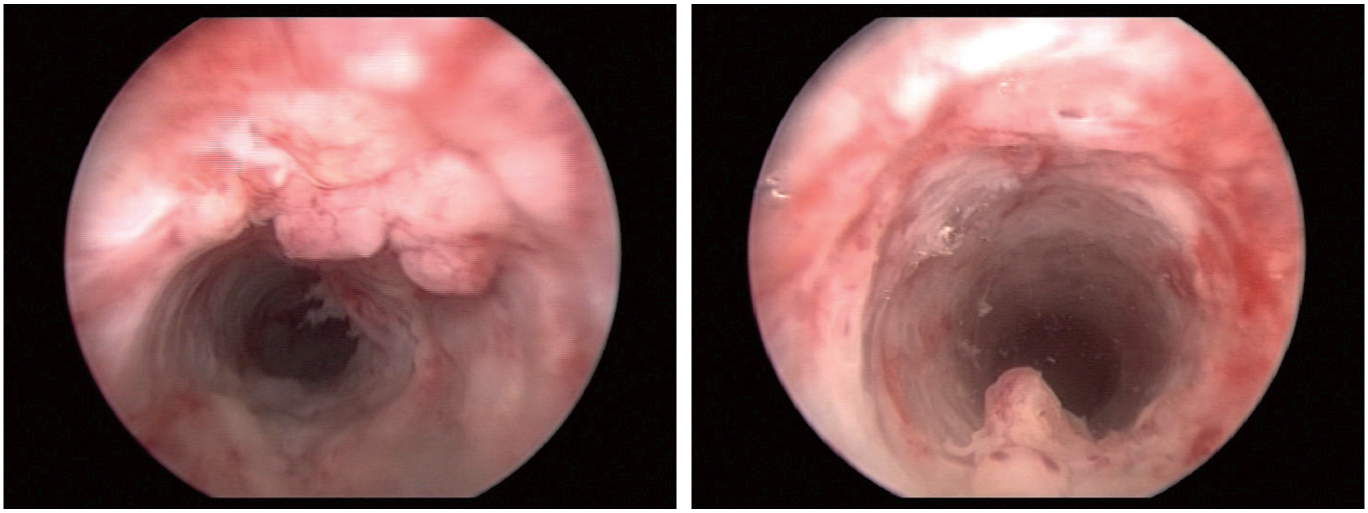

FIGURE 7.13 Urothelial tumoral formations in remaining urethra after radical cystectomy.

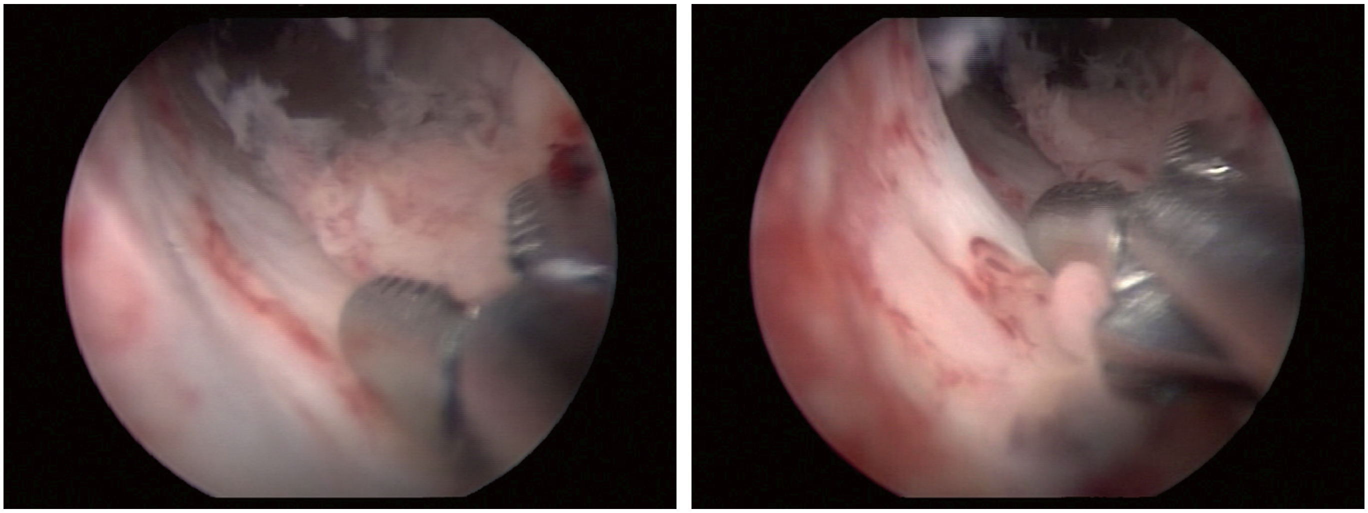

FIGURE 7.14 Forceps biopsy of urethral tumors.

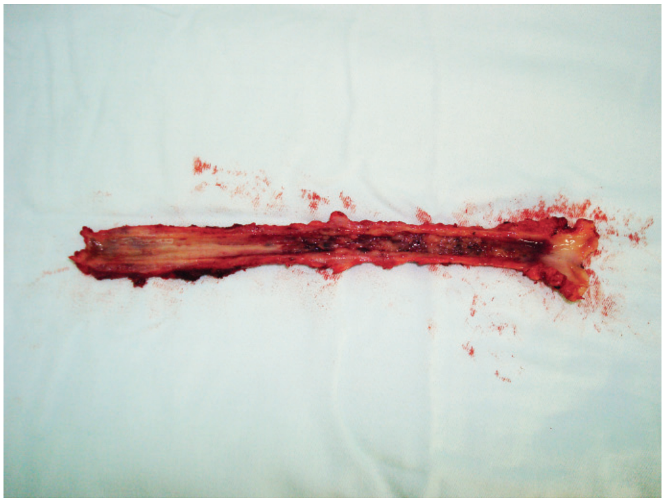

FIGURE 7.15 Urethrectomy piece.

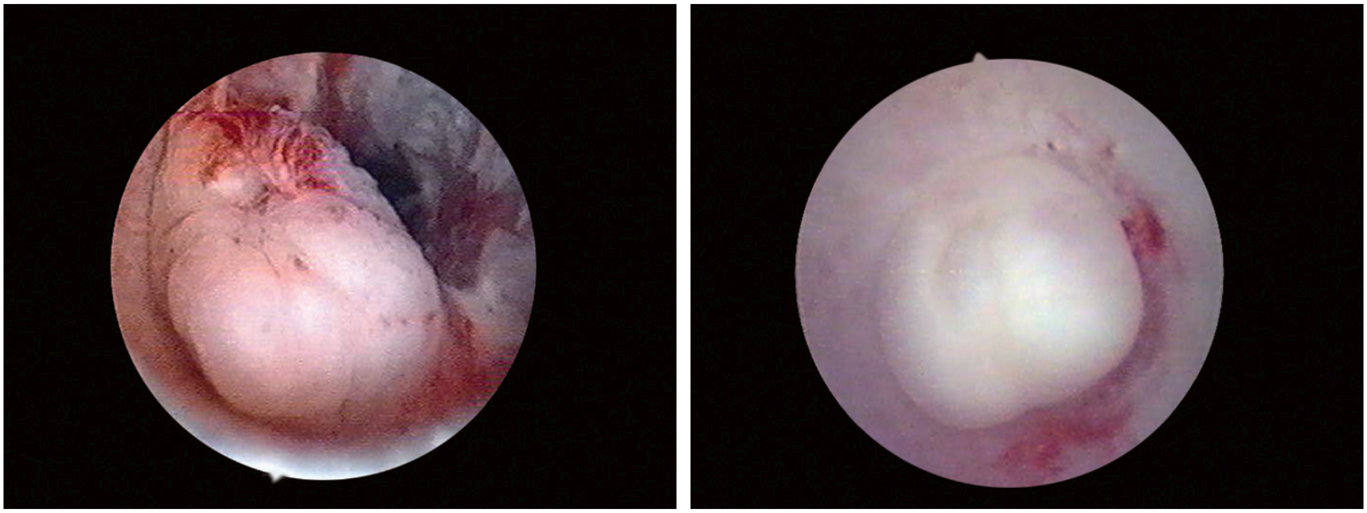

FIGURE 7.16 Tumoral urethral strictures.

7.2.2 Indications

All therapeutic indications are type 4 recommendations due to the reduced number of reported cases. These are mostly based on topographic criteria and tumor stage, and less on the histological type (Iborra et al., 2009). Endoscopic approach may a have diagnostic role in patients suspected of urethral cancer (Fig. 7.17).

For this purpose, cytology samples or tissue fragments have to be taken using "cold-cup" biopsy (Fig. 7.18) or transurethral resection. The reduced incidence of malignant urethral tumors and the frequent differential diagnostic problems with urethral strictures underline the importance of this diagnostic method.

Transurethral resection, electrofulguration, or laser ablation are used as therapeutic methods for superficial, well-differentiated lesions (Tis, Ta, and T1), provided that the patients are monitored by endoscopy on a regular basis (Konnak, 1980). Unfortunately, only 32% of cases are in this early stage when diagnosed.

Tumors of the anterior urethra are often superficial at the time of diagnosis, and therefore susceptible to conservative endoscopic treatment, as opposed to those of the posterior urethra, which are usually diagnosed at an advanced or metastatic stage (Zeidman et al., 1992). This situation occurs in both sexes, but the survival of the patients with distal urethral malignant lesions is superior to those with proximal tumors. In the case of invasive tumors, treatment involves open surgery with radical or palliative intent.

However, conservative treatment (transurethral resection) is technically easier for the management of malignant lesions of the prostatic urethra (Gillitzer et al., 2008).

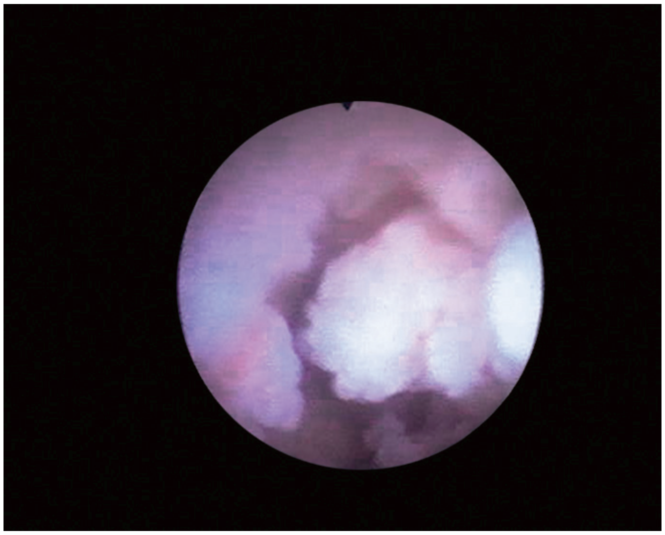

FIGURE 7.17 Urethral tumor in the bulbar segment.

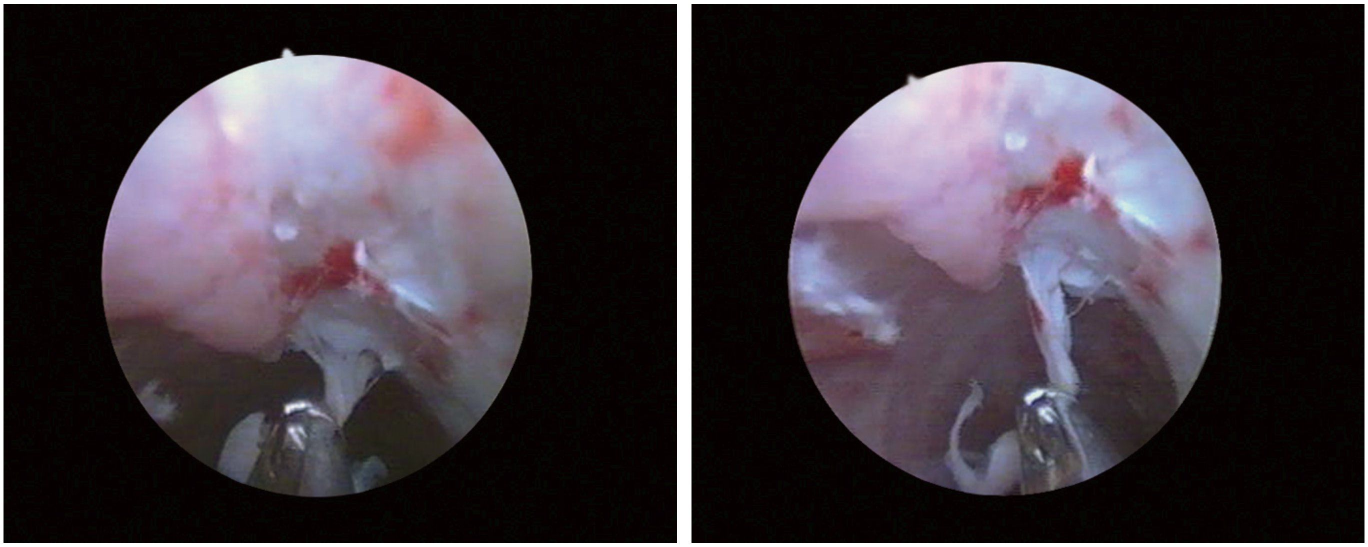

FIGURE 7.18 "Cold-cup" biopsy of a urethral tumor.

7.2.3 Techniques

7.2.3.1 Anesthesia

Interventions, whether for diagnosis or therapeutic purposes, are usually performed under local or regional anesthesia, with or without sedation. General anesthesia may be used if needed.

7.2.3.2 Patient Positioning

Interventions are performed using the classic lithotomy position, with the patient appropriately draped with sterile fields.

7.2.3.3 Endoscope Insertion and Inspection of the Urethra

This is performed under direct vision control. When a resectoscope is used, the insertion is preceded by distal urethral recalibration using the Otis urethrotome. Inspection under white light may be supplemented by the NBI technique (Fig. 7.19).

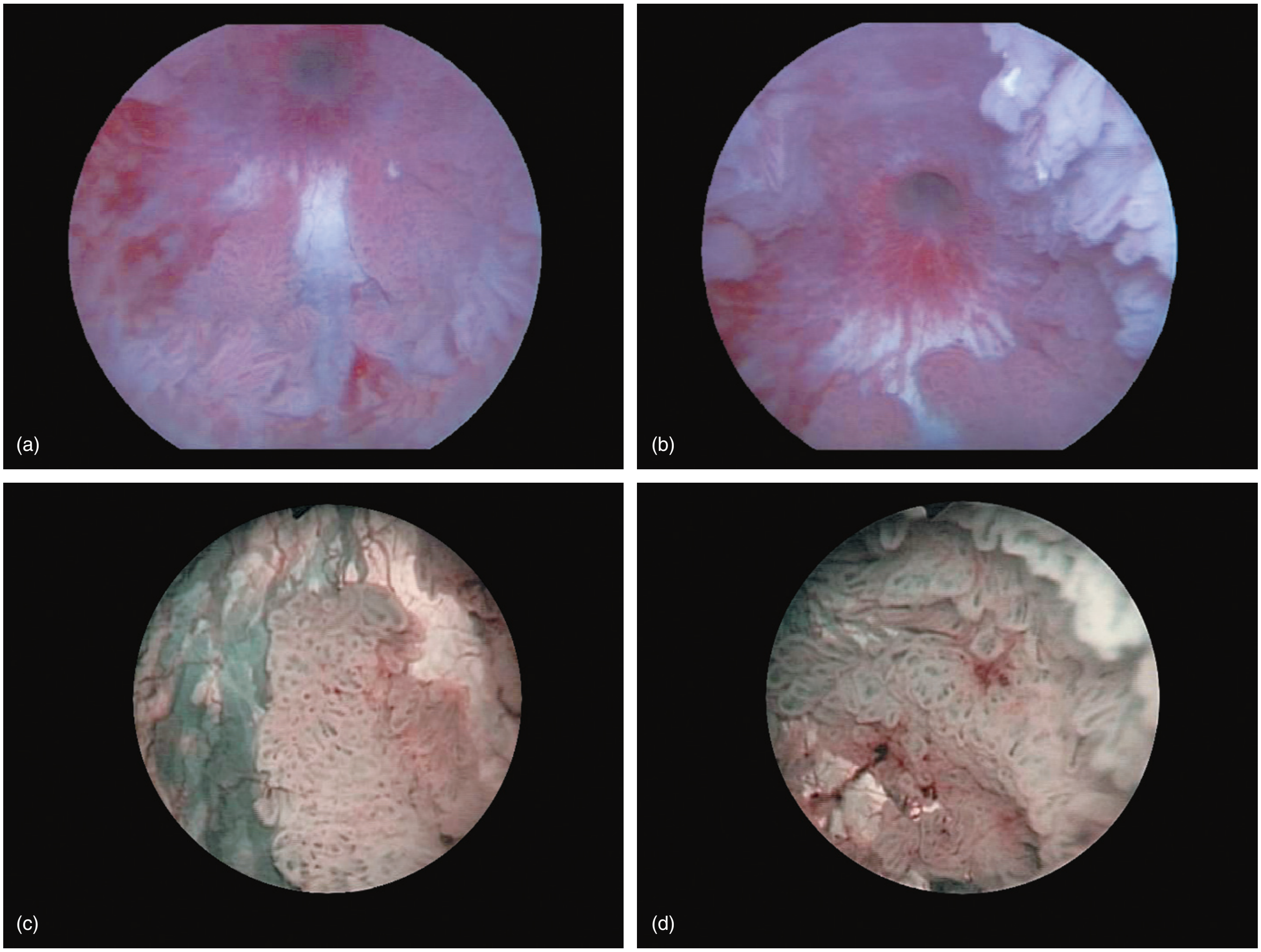

FIGURE 7.19 **Inspection under white light (a, b) and NBI (c, d) highlighting multiple tumors of the urethra in the bulbar segment.**

7.2.3.4 Transurethral Biopsy

Saline solution can be administered through the endoscope in order to irrigate and then harvest fluid for cytological examination. The collection of tissue fragments to confirm malignancy is performed either by "cold-cup" biopsy with forceps (Fig. 7.20) or by transurethral electroresection (Fig. 7.21).

Ideally, the biopsy specimens must contain part of the tumor and underlying healthy tissue for a more accurate identification of the stage and of the degree of differentiation (Fig. 7.22).

The Ho:YAG laser, which has reduced tissue penetrability, may be used to excise and provide noncauterized tissue fragments. Other lasers, such as Nd:YAG, may also be used to resect urethral tumors, although their high penetrability reduces the safety margin and increases the risk of complications.

7.2.3.5 Tumor Ablation

Tumor ablation can be achieved by continuing the electroresection into healthy tissue. Other options include electrofulguration with various types of electrodes (Fig. 7.23), vaporization, or laser excision (using Nd:YAG, Ho:YAG, argon, or CO_2 lasers). The excision is done by making deeper and deeper incisions around the tumor until the entire tumor is removed together with surrounding healthy tissue (Figs 7.24–7.26).

The Nd:YAG or CO_2 lasers, which have high tissue penetrability, cannot be usually used to excise tissue fragments. They are most commonly used for tumor destruction by vaporization, after "cold-cup" biopsy.

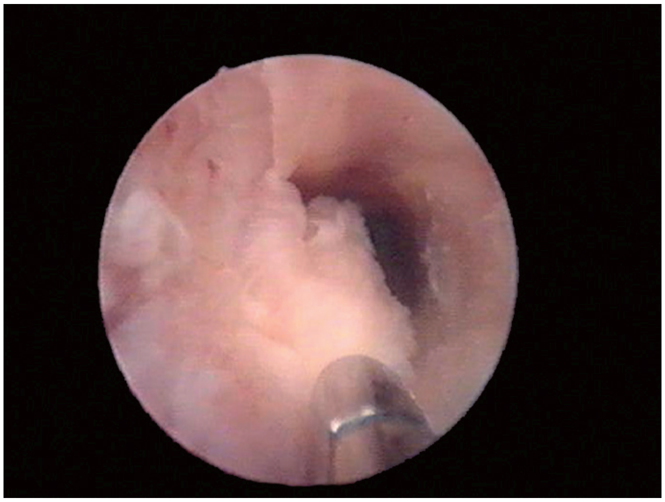

FIGURE 7.20 **"Cold-cup" biopsy of urethral infiltrative tumor.**

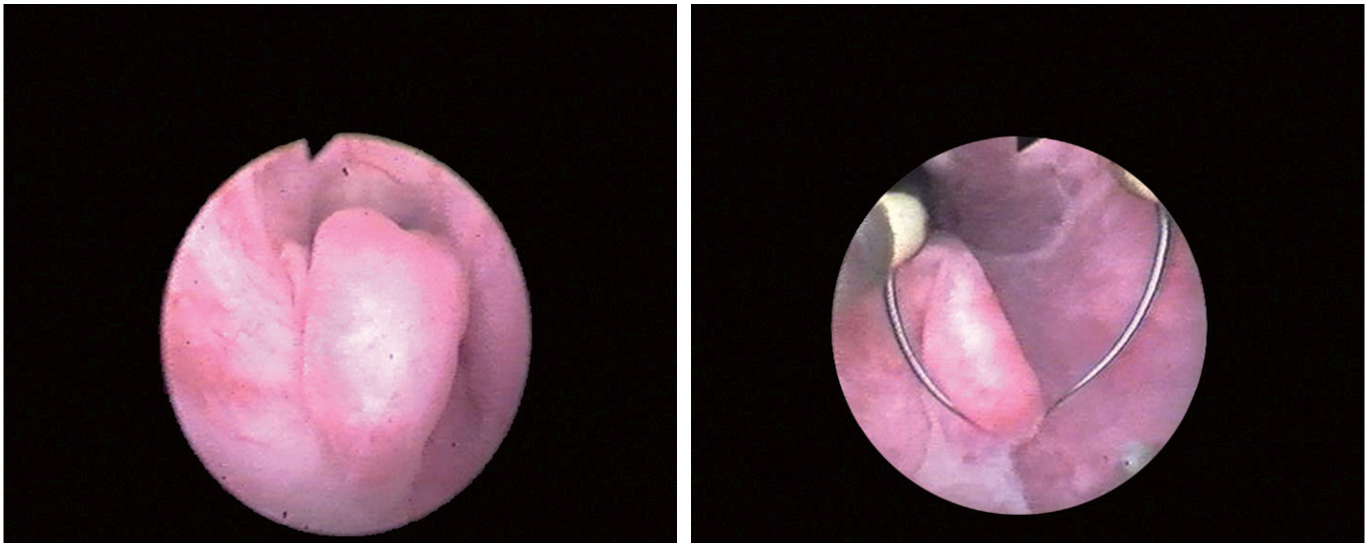

FIGURE 7.21 **Transurethral resection of a tumor.**

Destruction by electrofulguration or by vaporization is achieved gradually, similar to electroresection, until it reaches into healthy tissue.

7.2.3.6 Cystoscopy

Cystoscopy identifies possible synchronous bladder lesions.

7.2.3.7 Urethro-Vesical Catheterization

At the end of the procedure, a urethro-vesical catheter is inserted for a variable period of time, depending on the extension of the procedure. It is usually kept in place for 24–48 h.

7.2.4 Complications

Intraoperative bleeding complications are represented by vascular lesions, corpus cavernosum lesions, and perforations.

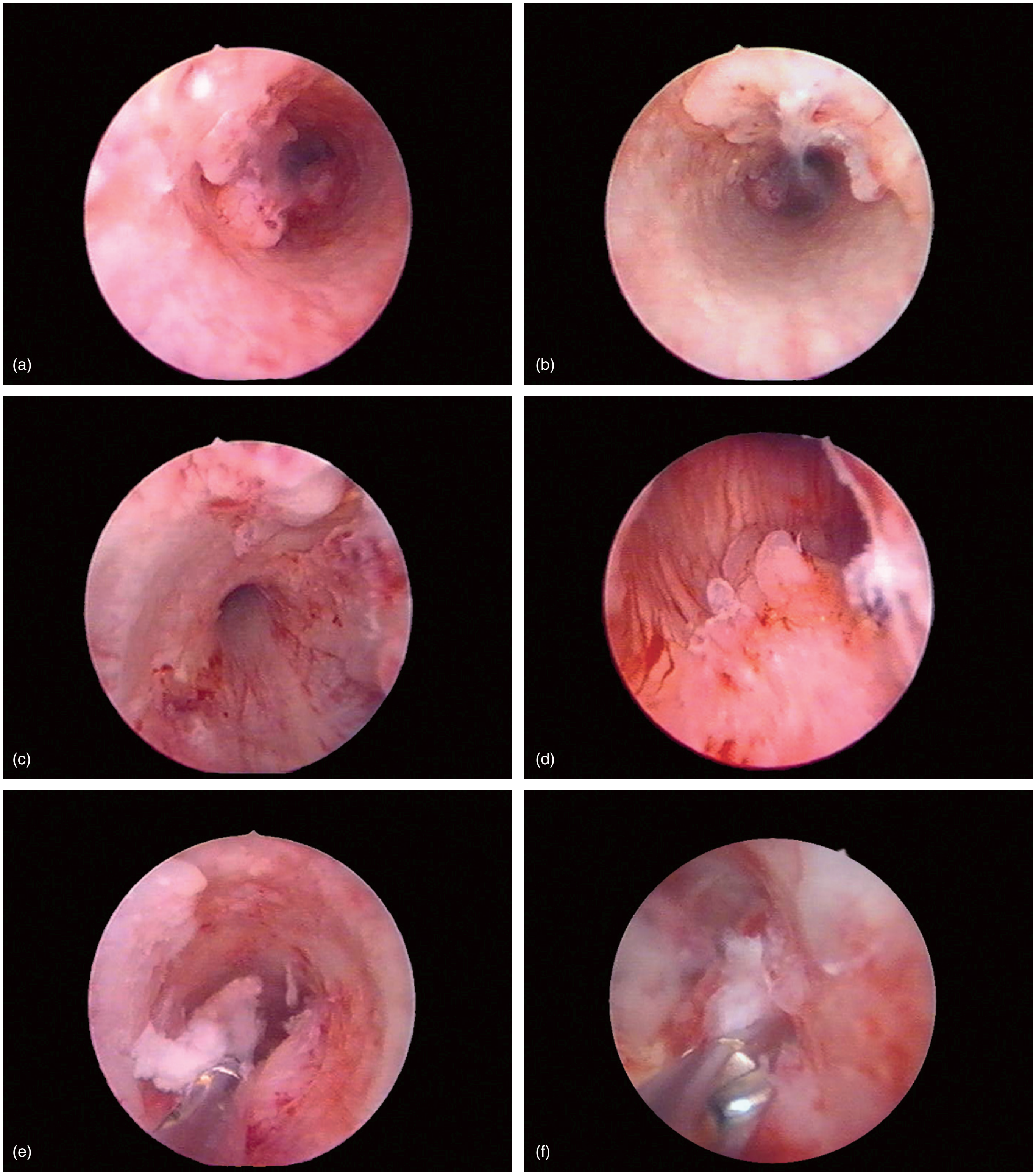

FIGURE 7.22 **Multiple tumors located in the penile (a, b), bulbar (c), and prostatic (d) urethra; forceps biopsy of the tumors (e, f).**

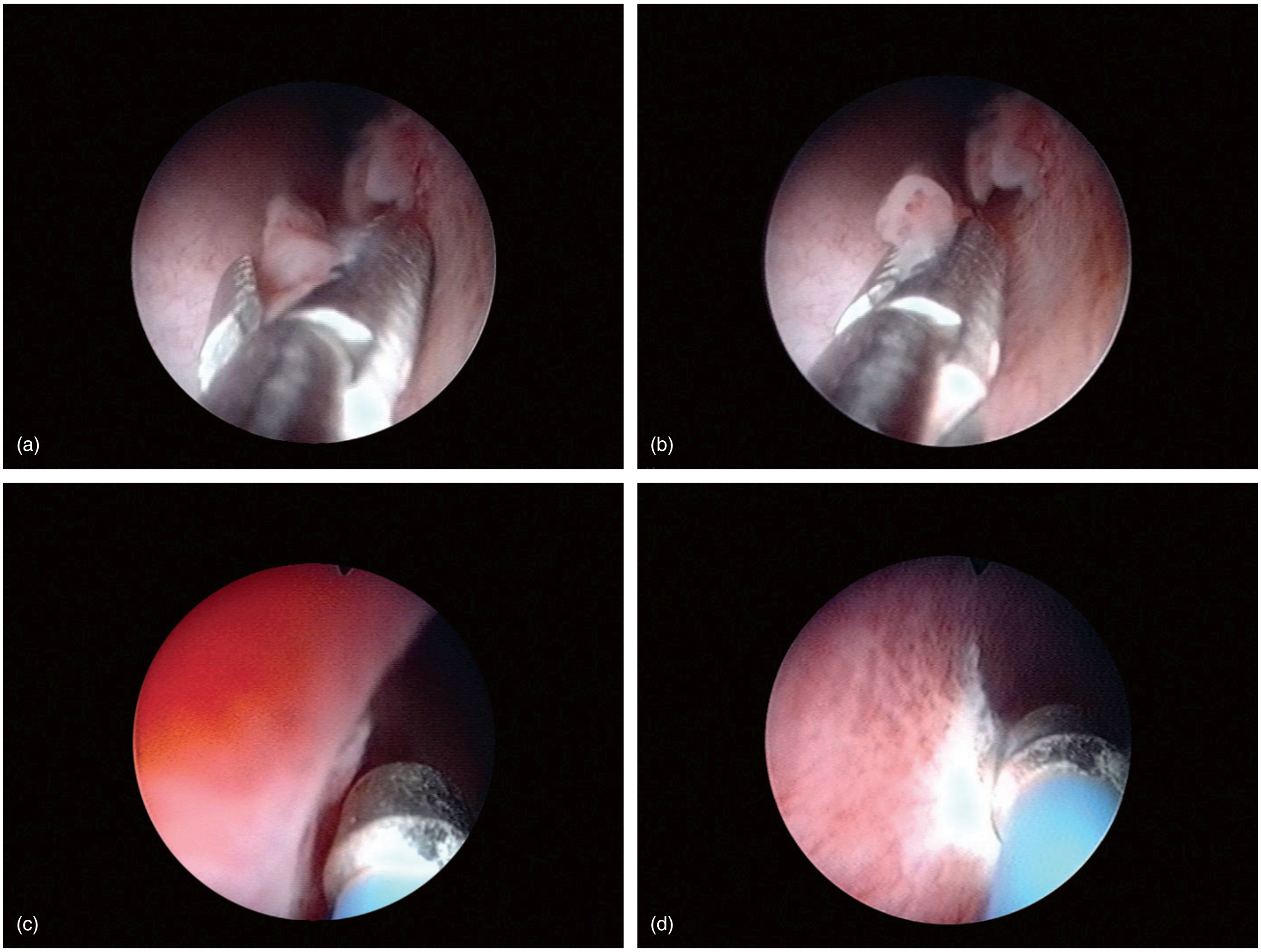

FIGURE 7.23 **"Cold-cup" biopsy of superficial malignant urethral tumors (a, b) followed by their electrofulguration (c, d).**

Postoperative septic complications can occur (from ordinary urinary infections to severe suppurative lesions), as well as bleeding (usually after erection) and as late complications, diverticulas, strictures, or fistulas. The most important late complication is relapse of the tumor.

7.2.5 Results

The efficiency of conservative endoscopic treatment of malignant urethral tumors is difficult to assess due to the low number of reported cases.

The results seem to be promising for well-differentiated noninvasive lesions, regardless of their histological type. Thus, Konnak (1980) reported good local control for an average of 6 years (ranging from 1 to 13 years) by applying conservative therapeutic endoscopic methods. However, the situation is different for invasive tumors, in which case the prognosis is reserved (Marshall, 1957).

Association of adjuvant chemotherapy has been proposed in an attempt to improve the efficiency of minimally invasive conservative treatment methods. Thus, Rothauge et al. (1981) reported a combination of chemotherapy with tumor ablation using argon laser. In a similar manner, Konnak (1980) associated endoscopic treatment with adjuvant chemotherapy in selected patients.

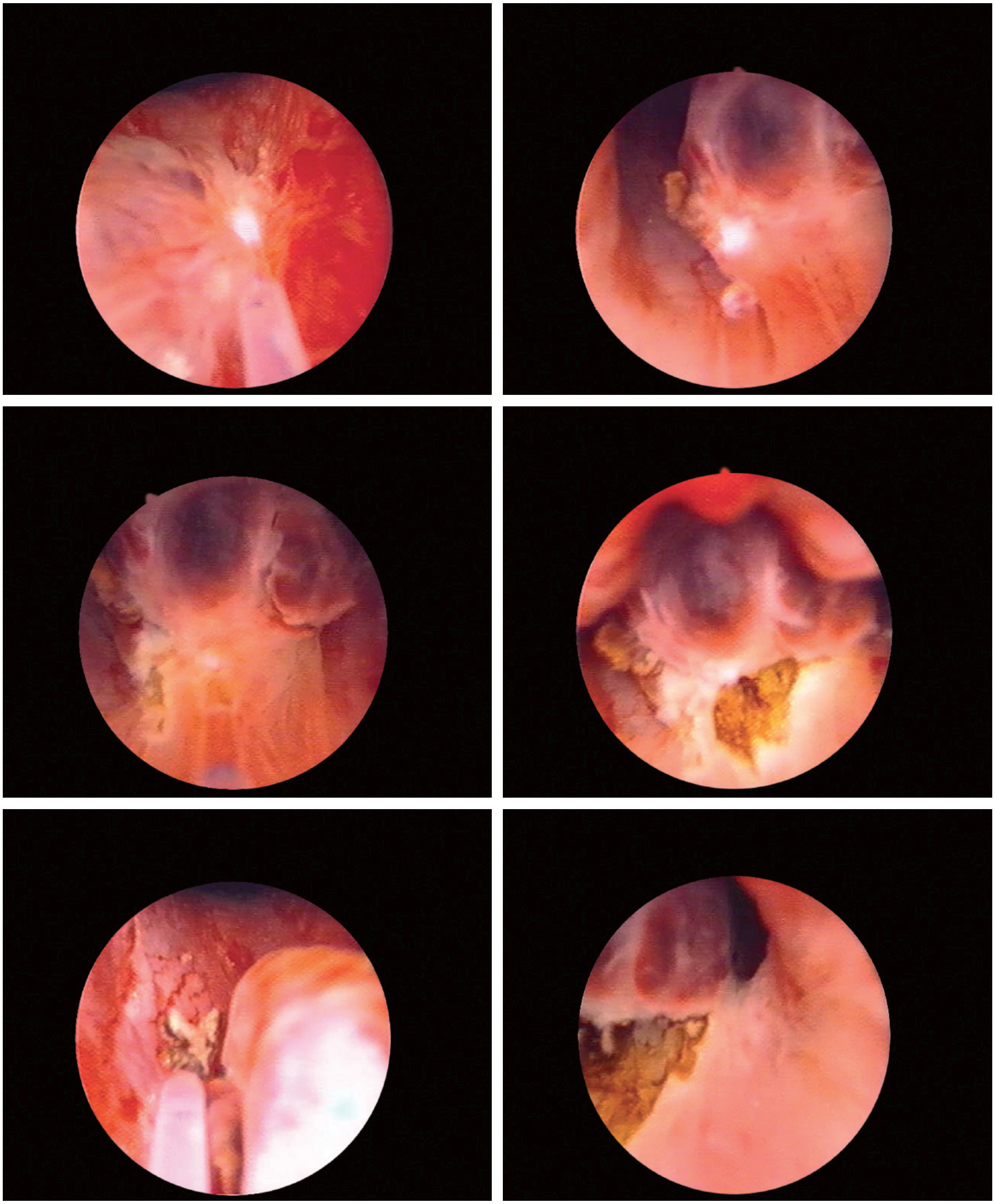

FIGURE 7.24 **Laser incisions that surround the tumor.**

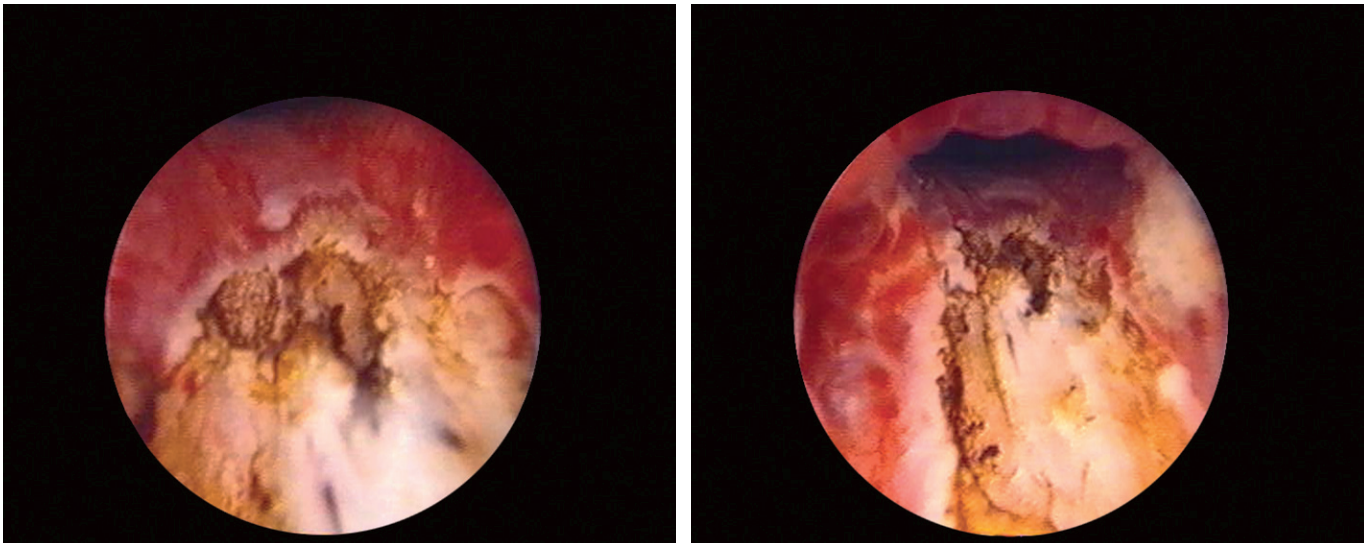

FIGURE 7.25 Deep incisions that surround the tumor and its removal along with adjacent healthy tissue.

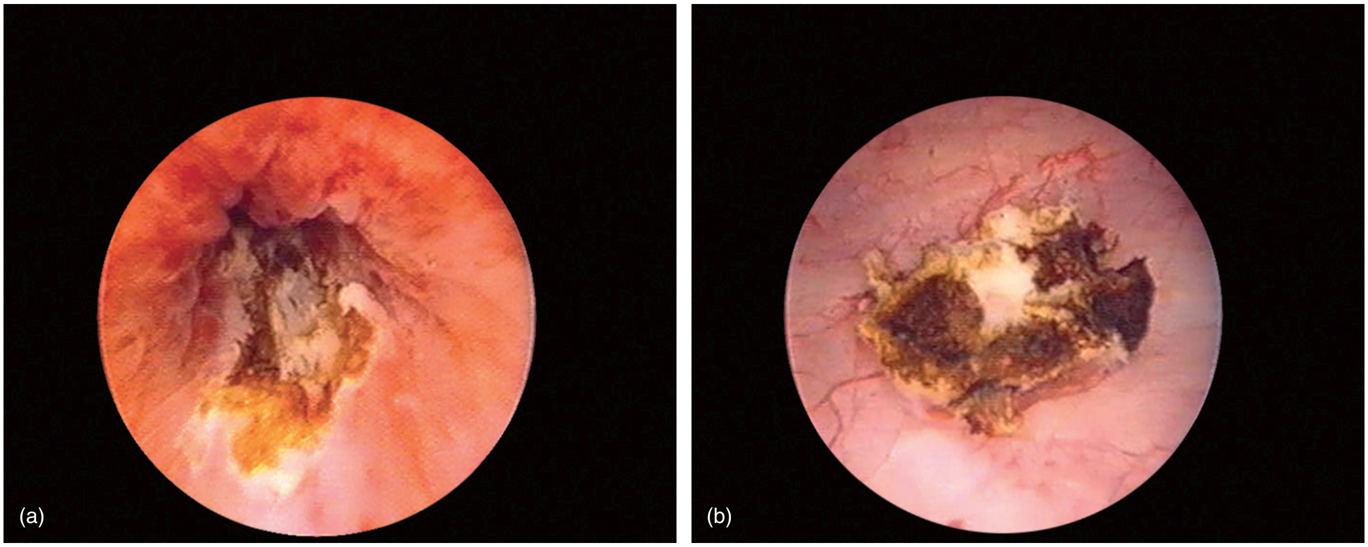

FIGURE 7.26 The aspect of the tumoral bed after the intervention (a) and the resected tumor (b).

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CHAPTER

8

Endoscopic Management of Urethral Trauma

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8.1 GENERALITIES

The management of urethral traumas (especially those of the posterior segment) is a controversial subject in urology. The main discussions are related to the efficiency of early surgical intervention with primary realignment compared with late surgical treatment under the protection of a cystostomy. Choosing one treatment method over another depends on the characteristics of the urethral lesions. For this reason, several different classifications have been proposed.

Depending on the affected anatomical segment, posttraumatic urethral lesions in males are divided as follows (Djokovic et al., 2010):

- Anterior – under the urogenital diaphragm, concerning the penile and bulbar urethra
- Posterior – above the urogenital diaphragm, concerning the membranous or prostatic urethra

Women only have a posterior urethra, the anterior urethra corresponding to the labia minor.

The American Association for the Surgery of Trauma proposed the following classification of urethral traumas:

- Grade I – Contusion: urethrography is normal; clinically there is blood on the urethral meatus.
- Grade II – Stretch injury: elongation of urethra without extravasation on the urethrography.
- Grade III – Partial disruption: extravasation of urethrography contrast at injury site with visualization in the bladder.
- Grade IV – Complete disruption: extravasation of urethrography contrast at injury site without visualization in the bladder; <2 cm of urethra separation.
- Grade V – Complete disruption: complete transaction with ≥2 cm urethral separation, or extension into the prostate or vagina.

The European Association of Urology has a classification that combines elements that are important in choosing the treatment method (Djokovic et al., 2010):

- Grade I – Stretch injury: elongation of the urethra without extravasation on urethrography.
- Grade II – Contusion: blood at the urethral meatus; no extravasation on urethrography.
- Grade III – Partial disruption of the anterior or posterior urethra: extravasation of contrast at injury site with contrast visualized in the bladder.
- Grade IV – Complete disruption of the anterior urethra: extravasation of contrast at injury site without/with contrast visualized in the bladder.
- Grade V – Complete disruption of the posterior urethra: extravasation of contrast at injury site without/with contrast visualized in the bladder.
- Grade VI – Partial or complete disruption of the posterior urethra, with associated tear of the vagina or bladder neck.

More than 90% of urethral traumas are closed traumas (Dixon, 1996). Posterior urethral traumas are a consequence of traffic accidents, falling or crushing, and are frequently associated with pelvic bone fractures. These orthopedic lesions are associated with urethral lesions in 4–19% of cases in men and 0–6% in women (Clark and Prudencio, 1972;

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Pokorny et al., 1979; Palmer et al., 1983; Lowe et al., 1988; Perry and Husmann, 1992; Koraitim et al., 1996; Hemal et al., 2000). Twenty five percent of lesions of the membranous prostatic urethra are stretch lesions, 25% partial disruptions, and 50% complete disruptions (Koraitim et al., 1996).

Anterior urethral traumas are a consequence of traffic accidents, falling, blows to the perineum, penile constriction (e.g., inadequate use of the urine collecting devices in paraplegic persons), and sexual intercourse. Another category of anterior urethral lesions is represented by iatrogenic lesions during endoscopies, dilation, or urethral catheterization. Regarding trauma that occurs during sexual intercourse, the most frequent lesions are lacerations of the corpus cavernosum albuginea, with association of urethral lesions in 20% of cases (Nicolaisen et al., 1983).

8.2 INDICATIONS

The management of urethral traumas is dictated by their characteristics, by the associated injuries, and by the general status of the patient. Controversies regarding the best treatment option are determined both by the heterogeneity of this group of conditions, as well as by the relatively small number of cases studied, which have not allowed for a universally accepted conclusion (Djokovic et al., 2010).

Closed traumas of the anterior urethra are usually treated by placing a urethro-vesical or suprapubic catheter. The latter has the advantage of protecting the affected area and reducing the risk of bleeding, additional damage, or infection. A radiological reassessment of the urinary tract is performed after 4 weeks. Penetrating wounds of the anterior urethra are usually resolved by open surgery. The treatment of posterior urethral trauma without complete disruption also involves inserting a urethro-vesical or suprapubic catheter. Any strictures are treated later either by endoscopy (for short strictures that do not have an intense spongiofibrosis process) or by urethroplasty (for long strictures).

Alternatives are available in case of complete disruptions (Djokovic et al., 2010):

- immediate
  - immediate urethroplasty (considered experimental, not recommended)
  - primary endoscopic realignment
  - primary open surgery realignment (applied only during open abdominal or pelvic surgery performed for associated lesions or for bones fixation)
- delayed
  - delayed primary urethroplasty (reconstruction at 2 weeks after trauma)
  - delayed urethroplasty (reconstruction at 3 months after trauma, when the hematoma has resorbed)
  - delayed endoscopic techniques, such as “cut-to-the-light” technique through the fibrous callus

The primary suture of the urethra is not routinely applied because of increased risk of complications, such as incontinence, erectile dysfunction, or restenosis (Koraitim, 1996). Currently, the two most widely used procedures used for complete urethral disruption are the early realignment and suprapubic drainage with delayed urethral reconstruction.

The first method, originally described by Ormand in 1934, and used in hemodynamically stable patients, involves restoring the approximate path of the urethra on a catheter and allowing the two ends of the urethra to bridge after the hematoma has resorbed. A suprapubic catheter is usually used; realignment is performed after 5–7 days, when the patient is stable and the active bleeding has stopped.

The purpose of primary realignment is mainly to reduce the distance between the two ends of the urethral disruption, and not to prevent urethral strictures formation. However, strictures that occur after this procedure are easier to treat because there is only a small amount of fibrous tissue in the urethra (Mundy, 1991).

Delayed reconstruction is recommended in hemodynamically unstable patients, with significant associated lesions, or in whom primary realignment has failed (Latini et al., 2006). Traumatic lesions of the female urethra are frequently associated with lesions of the bladder or of the bladder neck and require transvesical or transvaginal open surgery (Djokovic et al., 2010).

8.3 ENDOSCOPIC REALIGNMENT TECHNIQUE

8.3.1 Anesthesia

Endoscopic realignment is done under analgo-sedation, spinal, or general anesthesia. The general condition of the patient and any associated injuries are important parameters in determining the type of anesthetic regimen.

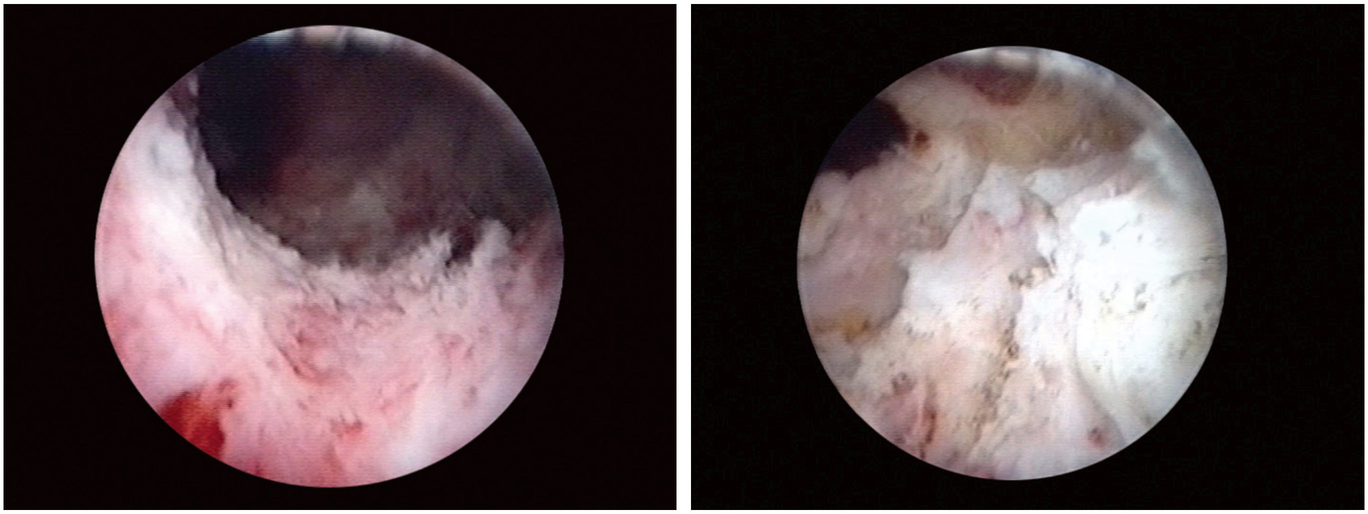

FIGURE 8.1 Insertion of the semirigid urethrocystoscope up to the proximity of the posttraumatic urethral interruption.

8.3.2 Positioning of the Patient

Ideally, realignment is done in the classic lithotomy position that allows easy access to the penis, abdomen, and perineum, which is essential in bipolar interventions. This positioning is only possible when there are no associated bone fractures or if the fractures are stable or have been orthopedically stabilized (Latini et al., 2006).

8.3.3 Accessing Both Ends of the Traumatized Urethra

Access is performed retrogradely using a rigid urethrocystoscope inserted under direct visual control at the urethral meatus (Fig. 8.1). Sometimes the real path of the urethra is identified by anterograde instillation of methylene blue (Fig. 8.2).

The suprapubic cystostomy path is dilated (if necessary) and a flexible cystoscope is inserted through it, also under direct visual control. After internal bladder inspection, the bladder neck is identified and the endoscope is guided toward the prostatic and membranous urethra.

8.3.4 Endoscopic Realignment

The rigid urethrocystoscope is oriented toward the cranial end of the urethral disruption, guided by the light of the flexible endoscope (Figs 8.3 and 8.4). After establishing visual contact between the two endoscopes (Fig. 8.5), a guidewire is anterogradely inserted through the flexible cystoscope and advanced through the working channel toward the rigid endoscope (Fig. 8.6).

Once the urethral path is determined, the two endoscopes are withdrawn and a urethro-vesical 18F catheter is advanced on the guidewire. An alternative method is to ascend the rigid urethrocystoscope with its half-sheath attached, toward the light of the flexible cystoscope (along the anterograde inserted guidewire or not), the latter being withdrawn progressively. This is continued until the end of the rigid endoscope reaches the bladder. At this stage the endoscopes are withdrawn, keeping the half-sheath in the urethra. The urethro-vesical catheter is inserted on the half-sheath using a straight mandrel.

8.3.5 Suprapubic Cystotomy

A cystostomy tube is inserted through the suprapubic path at the end of the intervention (Fig. 8.7).

8.3.6 Other Techniques

Some technical methods (dictated also by the level of technical equipment that the urology department has) involve the use of curved metal dilators anterogradely inserted instead of the flexible endoscopes. Once contact is

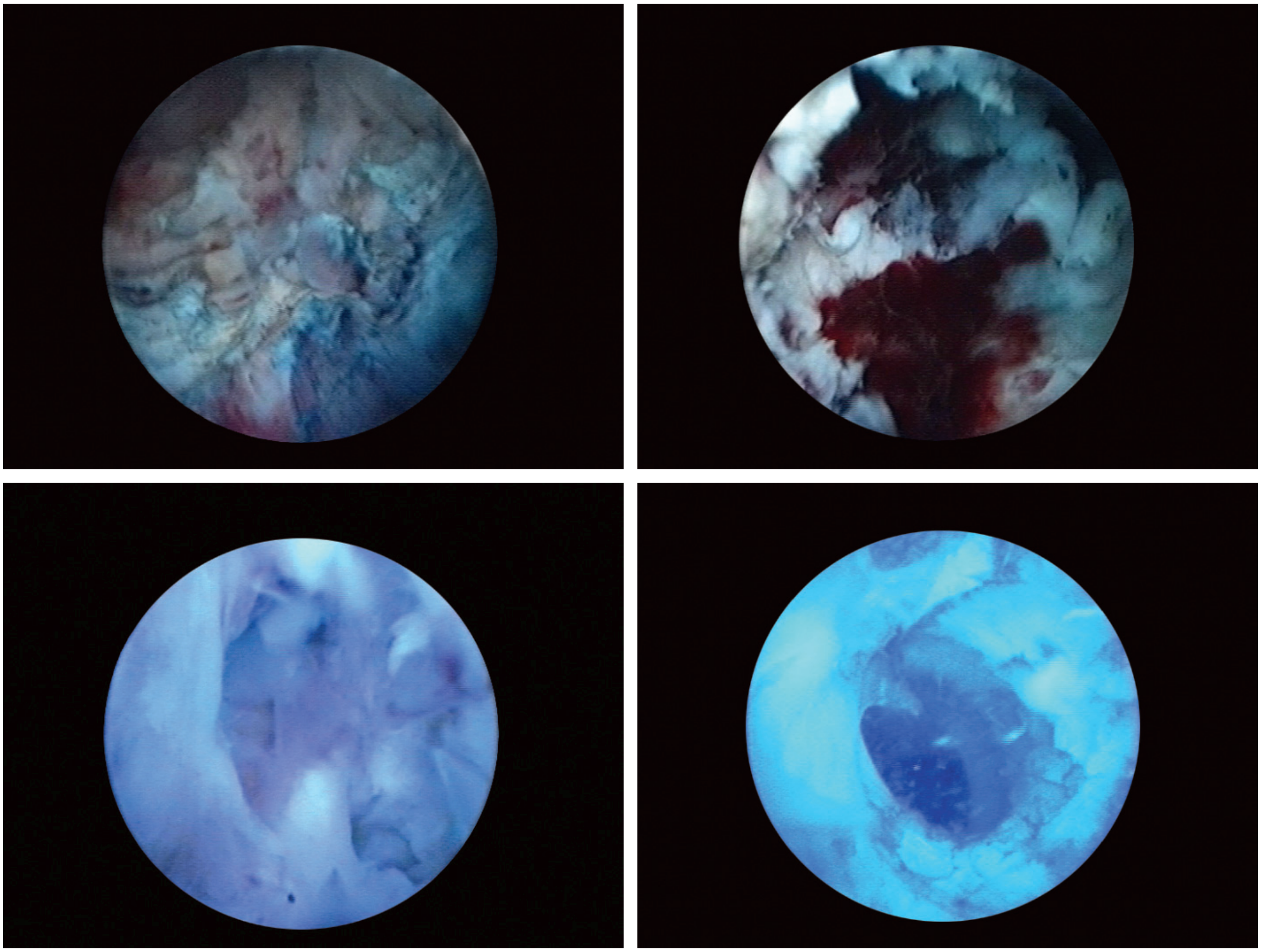

FIGURE 8.2 **Identifying the real urethral path by instillation of methylene blue.**

established between the rigid urethrocystoscope and the metal dilator, the endoscope fitted with the half-sheath is gradually ascended to the bladder.

Other alternatives involve retrograde and anterograde insertion of two metal catheters with magnetic ends or insertion of metal probes that can connect to each other (Djokovic et al., 2010).

8.4 POSTOPERATIVE EVALUATION

Four to six weeks after surgery, a safety guidewire is inserted into the lumen of the urethro-vesical catheter and is held in position after the catheter is extracted. A urinary cystourethrography is performed and if there is any extravasation of the contrast substance or if there is any urethral obstruction, a new urethro-vesical catheter is inserted on the metal guidewire for 2–3 weeks (Latini et al., 2006).

8.5 COMPLICATIONS

Several complications can occur during endoscopic realignment, such as bleeding, false passages (Fig. 8.8), etc. However, careful application of a technique allows the procedure to be performed in relatively safe conditions, with minimal handling of the periprostatic or periurethral tissues (Healy et al., 2007).

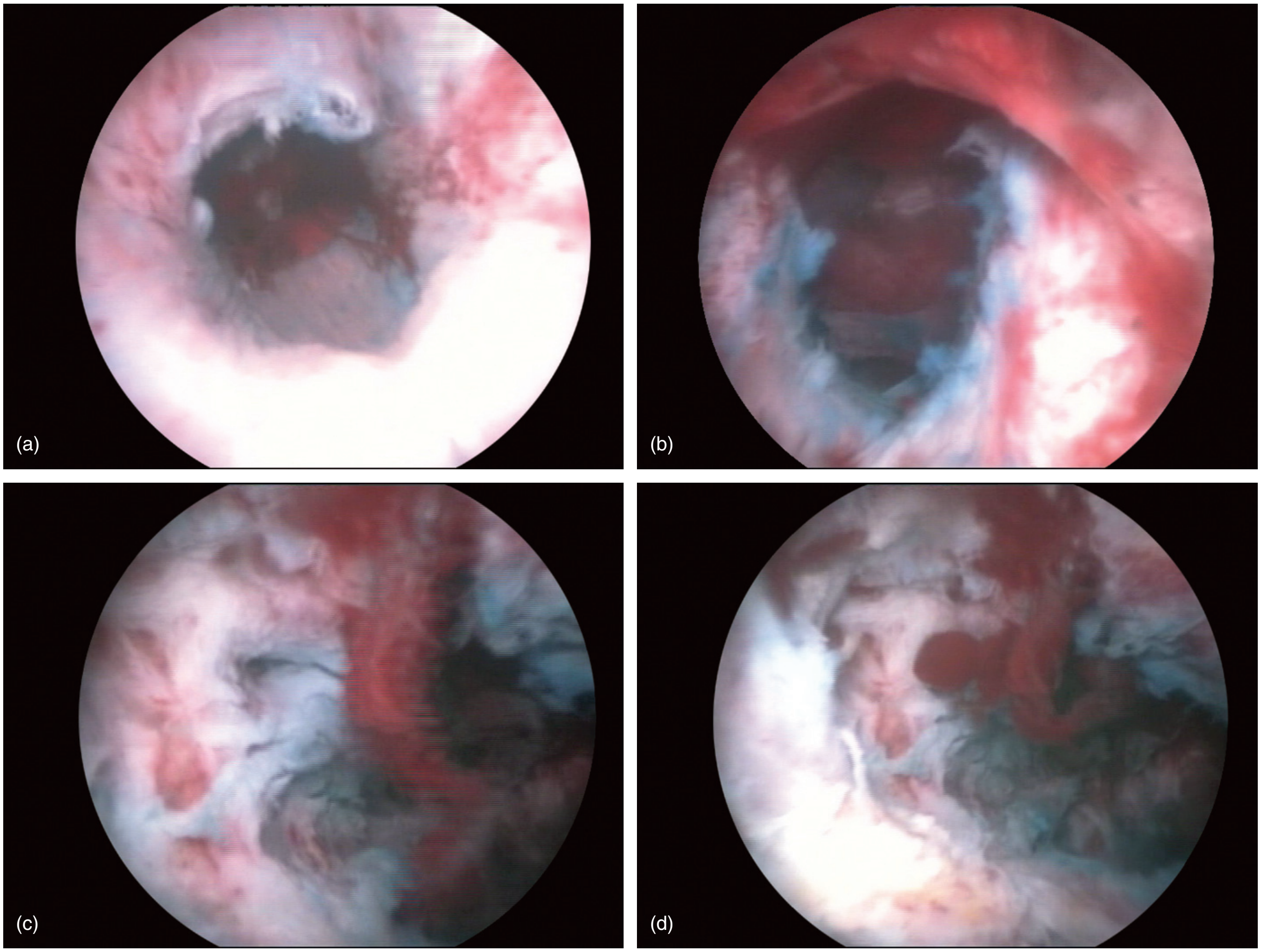

FIGURE 8.3 Insertion of the rigid urethrocystoscope up to the proximity of the damaged region (a, b), without managing to identify the cranial urethral lumen (c, d).

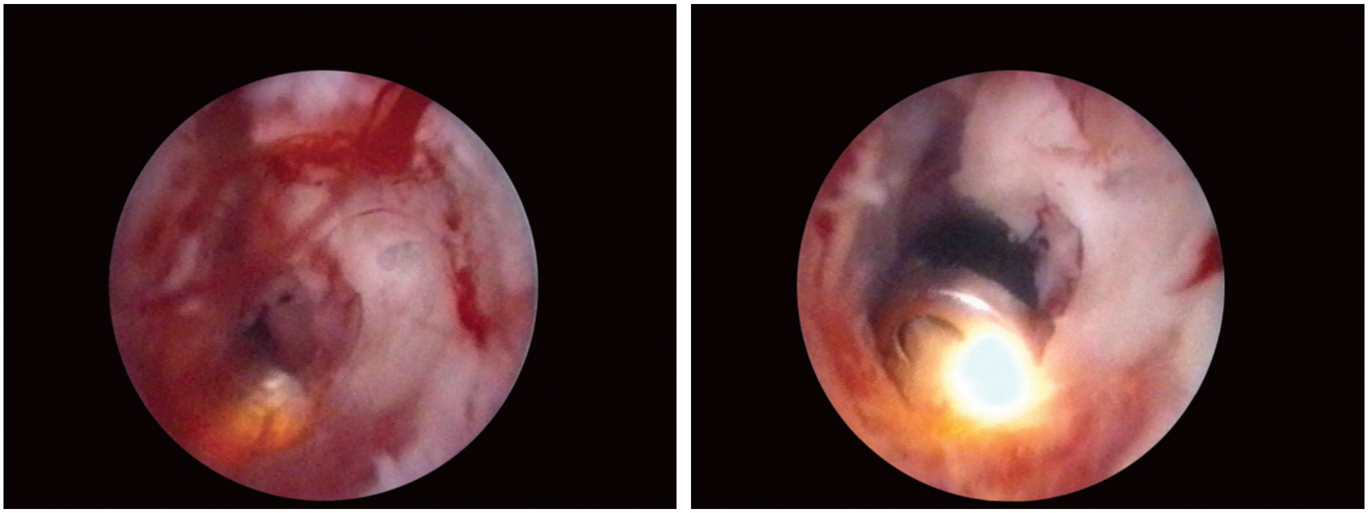

FIGURE 8.4 Ascending the rigid urethrocystoscope toward the light of the flexible endoscope, which was antegradely inserted.

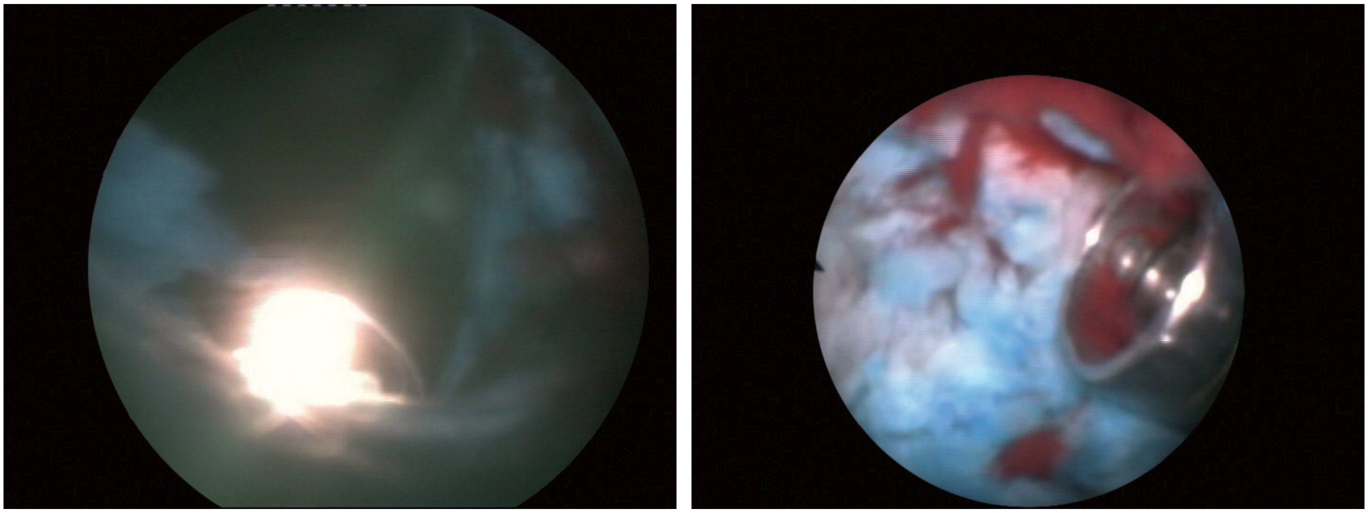

FIGURE 8.5 **Establishing contact between the ends of the two endoscopes.**

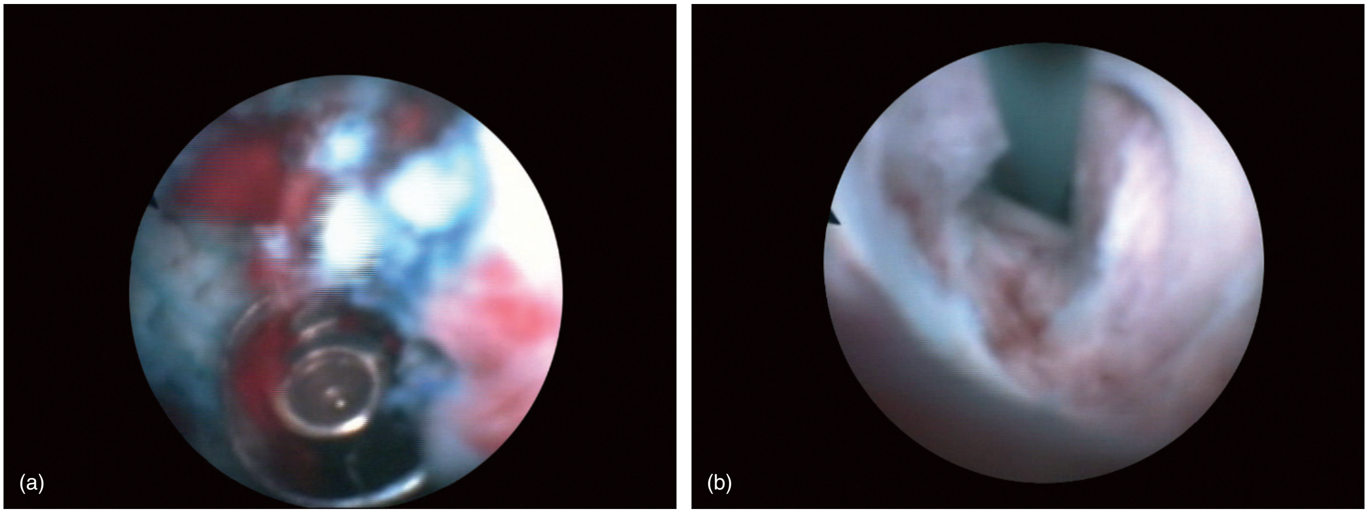

FIGURE 8.6 **Alignment of the flexible cystoscope with the distal end of the rigid one (a) and anterograde insertion of a metallic guidewire (b).**

Late complications can also occur in patients with pelvic trauma and urethral lesions, such as incontinence or erectile dysfunction (Table 8.1). However, these urinary and sexual complications seem to be rather a consequence of the trauma itself and not of the immediate treatment (Aşci et al., 1999).

Primary endoscopic realignment is associated with a low rate of complications, such as erectile dysfunction, incontinence or strictures, compared with delayed methods of treatment or open surgery (Jepson et al., 1999; Moudouni et al., 2001b).

8.6 RESULTS

Studies suggest that early endoscopic realignment determines a favorable outcome for patients (Table 8.2), with normal urination (possibly maintained with the help of a dilation schedule) in a proportion ranging between 25% and 100% of cases. There is no consensus on the optimal timing of the realignment, which is performed either immediately (Gheiler and Frontera, 1997; Ku et al., 2002), during the first week (Moudouni et al., 2001b), or even after more than 2 weeks (Kitahara et al., 2008).

Although some patients develop urethral strictures, the incidence of this complication is lower than in patients who undergo cystostomy followed by delayed treatment. Thus, the incidence of urethral strictures varies between

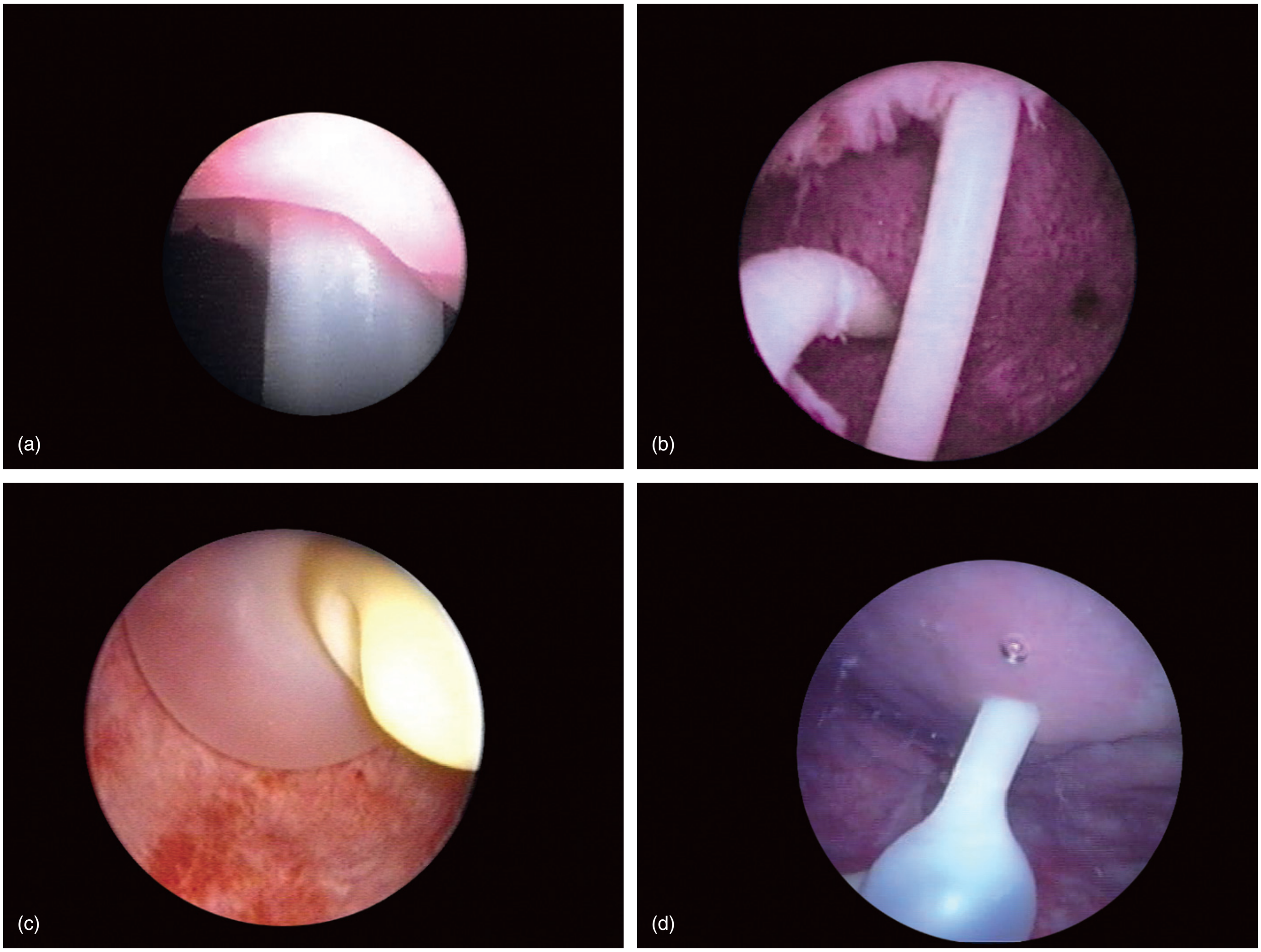

FIGURE 8.7 Endoscopic appearance of a cystostomy catheter: mono J (a, b) or Foley (c, d).

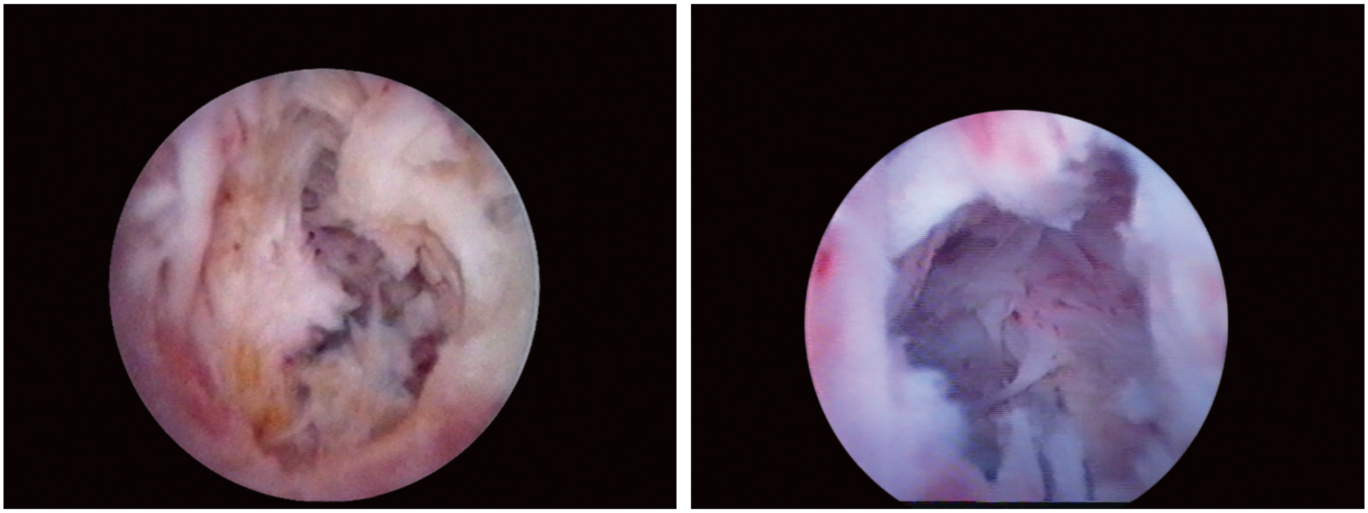

FIGURE 8.8 False passages created during attempts of endoscopic realignment.

TABLE 8.1 The Rate of Urinary Incontinence and Erectile Dysfunction in Groups of Patients who Underwent Primary Endoscopic Realignment

Authors	No. of patients	Erectile dysfunction (%)	Incontinence (%)
Cohen et al. (1991)	5	60	20
Guille et al. (1991)	5	20	0
Follis et al. (1992)	20	20	10
Elliott and Barrett (1997)	53	21	3.8
Gheiler and Frontera (1997)	3	0	0
Aşci et al. (1999)	20	20	10
Jepson et al. (1999)	8	37.5	12.5
Tahan et al. (1999)	13	23.1	0
Ying-Hao et al. (2000)	16	0	0
Moudouni et al. (2001a)	29	13.7	0
Moudouni et al. (2001a)	30	20	0
Kielb et al. (2001)	6	0	16
Tazi et al. (2003)	36	19.4	0
Mouraviev et al. (2005)	57	34	17.5
Healy et al. (2007)	10	40	0

TABLE 8.2 Results of Primary Endoscopic Realignment in the Management of Urethral Traumatic Disruption

Authors	No. of patients	Success after isolated realignment (%)	Success after realignment and optical urethrotomy (%)	Follow-ups (months)
Cohen et al. (1991)	5	80	–	–
Guille et al. (1991)	4	25	75	12
Londergan et al. (1997)	7	85.7	–	1–35
Gheiler and Frontera (1997)	3	67	0	6
Aşci et al. (1999)	20	55	35	39
Jepson et al. (1999)	8	37.5	50	50.4
Tahan et al. (1999)	13	61.5	38.5	29
Ying-Hao et al. (2000)	16	100	0	39–85
Moudouni et al. (2001a)	30	73.3	23.3	30
Kielb et al. (2001)	6	50	33.3	18
Ku et al. (2002)	65	81.5	18.5	–
Tazi et al. (2003)	36	63.8	–	34
Maheshwari and Shah (2005)	7	57.1	28.6	49.2
Healy et al. (2007)	8	50	50	41.4

14% and 50% in patients who underwent primary realignment versus 40–100% in those who preferred delayed treatment (Jepson et al., 1999; Moudouni et al., 2001b; Ku et al., 2002; Hadjizacharia et al., 2008). Moreover, this difference is maintained even if only severe cases with complete disruptures of the urethra are taken into account (31.3% vs. 68.8%) (Ku et al., 2002).

Primary realignment seems also to influence the severity of potential strictures, which are usually simpler and, therefore, can be managed in a less invasive manner (Jepson et al., 1999). Only 10% of patients with this type of treatment required urethroplasty compared with 44% of those who underwent cystostomy and delayed treatment (Aşci et al., 1999).

Some authors recommend dilations or intermittent self-catheterization for 3 months after the urethro-vesical catheter is removed (Cohen et al., 1991), while others use them in selected cases throughout the entire follow-up period (Ying-Hao et al., 2000). In case of failure and stricture formation, primary realignment does not influence the success rate of a potential urethroplasty (Moudouni et al., 2001b).

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CHAPTER

9

Difficult Urethro-Vesical Catheterization

Răzvan Mulţescu, Dragoş Georgescu, Bogdan Geavlete

9.1 GENERALITIES

The most frequently used invasive urologic procedure is probably the insertion of a urethro-vesical catheter. However, although seemingly simple, in particular cases it may raise a number of issues, turning the urologic event into a complex case with a huge potential for iatrogenic injuries to occur. For this reason, even if urethro-vesical catheterization is not exclusive to endourology, we believe that the presence of this section is welcome. In addition, an endoscopic approach may be necessary to effectively insert the catheter or, especially, to solve the complications. In the vast majority of cases, these difficulties occur in male patients. Urethral pathology (strictures, stones, tumors, etc.), prostate pathology (benign hyperplasia, adenocarcinoma, etc.), interventions in the past on the lower urinary tract, changes to the foreskin (phimosis, massive edema), neurological disorders, and noncompliant patients are all factors that can make insertion of a urethro-vesical catheter a difficult maneuver. Similarly, improper use of catheters and this invasive procedure practiced by persons who are unqualified or with little experience can create prerequisites for urethral injuries (Straffon, 1984). A simple urethro-vesical catheterization is often transformed into a difficult maneuver by previous improper attempts practiced by nonurologic personnel.

To establish the proper technique, one must correctly identify its nature and its position (urethral, prostatic, or at the bladder neck). To do so, a thorough anamnesis with a review of the patient's history is required. Any failed attempts of catheterization should also be documented, including details about:

- the person/people who attempted catheterization (urologist, doctor with a different specialty, nurse, previous experience, etc.);
- the type of catheter used, possibly a harsh model, with the potential to perforate the lower urinary tract;
- the distance between the urethral meatus and the obstacle: a length of less than 16 cm usually indicates urethral pathology while one of more than 16 cm indicates prostate or bladder neck pathology;
- the existence of an episode of balloon inflation without having any urine drained through the catheter: can occur in the case of a faulty technique, when the distal end of the catheter did not overpass the bladder neck (Fig. 9.1) or had created a false passage, suggesting damage to the urethral wall or prostatic lodge;
- the presence of blood in the urethral meatus: this is often an indicator of iatrogenic urethral lesions (Fig. 9.2).

9.2 URETHRO-VESICAL CATHETERIZATION TECHNIQUE

Inserting an urethro-vesical catheter requires adequate access to the urethral meatus. After the foreskin is retracted, the penis is positioned at a 45° angle from the plane of the body in order to eliminate the caudal curvature and to stretch the urethra. The catheter, well lubricated with gel (possibly containing 2% lidocaine), is inserted into the urethra and advanced progressively until the rectilinear portion is fully inserted. One meta-analysis demonstrated that there is no significant difference regarding the comfort of the patient between catheterization with simple gel or with gel containing 2% lidocaine (Patel et al., 2008).

In anxious and noncompliant patients, the contraction of the pelvic musculature can prevent the catheter from passing through the external sphincter. Therefore, all patients are instructed to relax, breathe deeply, and keep their legs straight, in a slight external rotation. Sometimes, the urologist must wait with the distal end of the catheter in the vicinity of the sphincter for the moment when the patient relaxes it.

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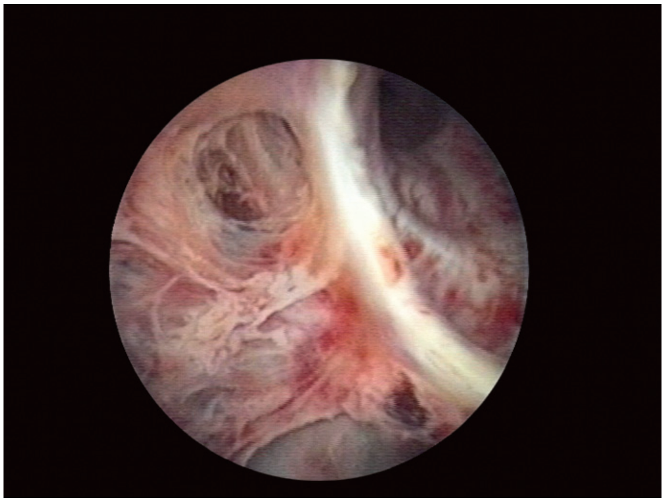

FIGURE 9.1 **Urethral wall damage by inflating the balloon of the catheter at the prostatic lodge level.**

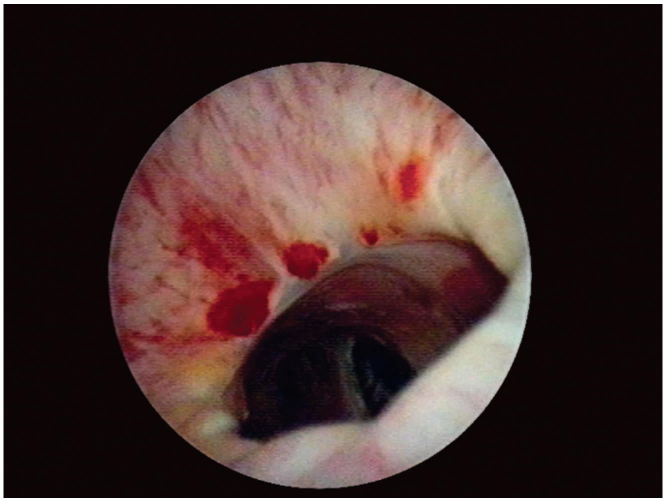

FIGURE 9.2 **Iatrogenic false passage after an attempt to insert a urethro-vesical catheter.**

Before inflating the balloon, one must verify that the distal end of the catheter is inside the bladder, evidenced by urine drainage through the catheter. The absence of this phenomenon may mean that the catheter has not advanced enough, that there is a false passage, or simply that there is no urine in the bladder.

After inflating the balloon with 10–15 mL of saline fluid, the catheter is gently retracted until it comes into contact with the bladder neck.

9.3 MANEUVERS FOR DIFFICULT URETHRO-VESICAL CATHETERIZATION

Difficult catheterization involves the use of different maneuvers to overcome the obstacle. We further describe these techniques in the order in which they can be applied, while keeping the risk of iatrogenic damage as small as possible.

9.3.1 Accessing the Urethral Meatus

Tight phimosis or massive foreskin edema in patients with anasarca may prevent insertion of the urethro-vesical catheter.

In patients with phimosis, gaining access to the urethral meatus may involve circumcision or at least dorsal incision of the foreskin. If the penile skin is edematous, the foreskin can be retracted with various retractors until the meatus is exposed. Walden (1979) has described the use of a vaginal speculum in such patients (one patient had 220 kg, and a foreskin of 11 cm).

In case of stenosis of the meatus, it can be recalibrated by using expansion bougies or by cold blade incision.

9.3.2 Transurethral Instillation of Lubricants or Saline

Various authors have proposed instillation of lubricant gel in large quantities (20–30 mL) as a useful solution in some cases of difficult catheterization (Jordan et al., 1985). This maneuver ensures, besides additional lubrication, the opening of the lumen by hydraulic dilation.

Cancio et al. instilled 10–20 mL of lidocaine gel, using high-gauge catheters (20–24F) in patients with benign prostatic hyperplasia, and small-gauge catheters (14–16F) in patients with urethral strictures. Perineal pressure can also be applied by an assistant to ease the catheter's guidance at the bulbar level (Cancio et al., 1993). For a similar effect, other authors recommend injecting 60 mL of saline solution into the catheter as it ascends (Harkin et al., 1998).

Although this method has been reported in the literature as having increased effectiveness, it is logical to assume that it will fail in many cases of urethral stricture, bladder neck sclerosis, or associated false passages, these being the most common causes of difficult catheterization (Villanueva and Hemstreet, 2008).

9.3.3 Using a Catheter with Increased Axial Rigidity

In cases of difficult catheterization it is recommended to use a catheter with a minimum caliber of 16–18F. Although it seems paradoxical, smaller caliber catheters are associated with a higher rate of catheterization failure. The reason for this is the fact that, in difficult conditions, increased flexibility prevents the ascension of thin catheters and promotes their bending at the intraurethral or prostatic lodge level. Theoretically, an 18F catheter will allow catheterization in most cases of benign prostatic hyperplasia, or of previous failed attempts due to improper handling technique (Villanueva and Hemstreet, 2008).

Liss et al. inserted a Super Stiff guide into the main path, thus increasing the axial stiffness of a thin catheter by almost 360%. Thus, 12–14F catheters gain, at their urethral portion, rigidity similar to those of 20F without having their distal part lose flexibility. This increases the efficiency of the catheterization without increasing the risk of urethral perforation (Liss et al., 2009).

Using rigid catheters such as Nelaton type catheters can cause iatrogenic urethral damage and because they are not autostatic, they raise attachment issues.

9.3.4 Using a Metallic Mandrin

The catheter can be mounted on a curved mandrin in order to increase its axial stiffness and its active guidance. The insertion of the catheter is achieved through a complex motion combining an upward push through the urethra with a rotation in the sagittal plane, from the abdomen toward the thighs. This is accomplished in a manner similar to that of insertion of a Benique metallic dilator, which was described previously.

The ascending of the assembly catheter–mandrin should be carried out by sliding along the urethral wall with structural integrity. If an intrusion of the distal tip of the catheter into a false passage is suspected, this is withdrawn a few centimeters and then advanced again while being in contact with the opposite wall, which is supposedly intact.

As using a curved mandrin has a huge potential for iatrogenic urethral injuries (Fig. 9.3), this maneuver is controversial, being discouraged or even forbidden in some countries.

9.3.5 Guidewire Catheterization

Guidewire catheterization is done in a manner similar to that of urethral stenting. Thus, a hydrophilic Terumo type guidewire is inserted transurethrally. This has the advantages that it slides easily, which increases the likelihood that the obstacle is surpassed, and is flexible, thus reducing the risk of injury. If the obstacle is not surpassed or the guidewire enters into a false passage, usually the distal end of the guidewire will return to the urethral meatus where

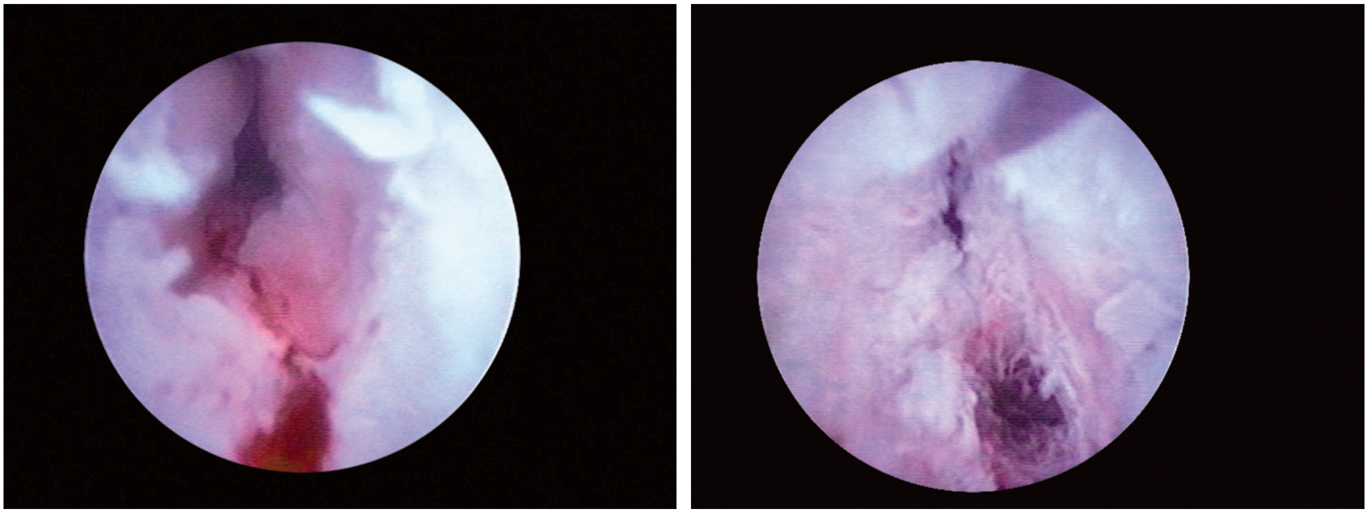

FIGURE 9.3 **Perforations of the urethral wall with false iatrogenic passages produced during attempted insertions of urethro-vesical catheters with curved mandrins.**

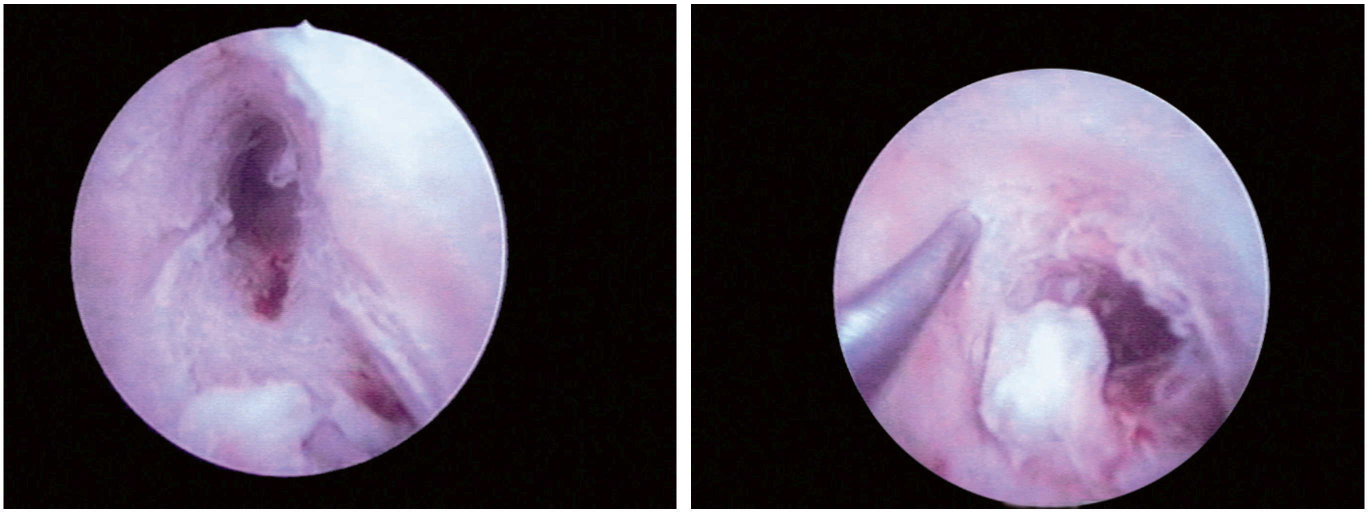

FIGURE 9.4 **Identification of the real urethral lumen, which is lateral to a false passage, and insertion of a hydrophilic guidewire into it.**

it will become visible. Typically, the absence of this phenomenon indicates the correct position of the guidewire inside the bladder (Villanueva and Hemstreet, 2008).

Once the distal end of the guidewire reaches the bladder, a thin ureteral catheter is mounted on the guidewire. After the guidewire is withdrawn, the correct position of the catheter is verified by aspiration of urine. Later, another, more rigid, polytetrafluoroethylene-coated guidewire is mounted on the catheter. This is used to guide the Foley catheter, which is well lubricated and modified using the tip of a needle to have an orifice at its tip (Freid and Smith, 1996).

9.3.6 Visually Controlled Catheterization

When other methods fail, catheterization may be performed under endoscopic control using rigid or flexible cystoscopes. Several variants of this method have been described. Some involve overcoming the obstacle with a guidewire, followed by ascending the catheter on the wire (Fig. 9.4), similar to the previous method (Krikler, 1989; Beaghler et al., 1994).

This technique is used especially after previous attempts of catheterization with formation of false passages into which the hydrophilic end of the guidewire enters, thus making its ascension to the bladder impossible without endoscopic control. In these patients, the rigid cystoscope, and especially the flexible cystoscope, allow for visualization of these defects of the urethral wall, for identifying the real lumen and for advancing the guidewire beyond the bladder neck (Villanueva and Hemstreet, 2008). Occasionally, this method can be associated with dilation or incision of the stenosed urethral segment (Fig. 9.5).

In other techniques the cystoscope (with a metal half-sheath or a circular "peel-away" type sheath) is inserted into the bladder (Villanueva and Hemstreet, 2008). Certain patients may require treating the pathology that prevents the catheterization (urethral strictures, stones, etc.).

The sheath is held in place after the withdrawal of the cystoscope and is used to help the insertion of the urethro-vesical catheter mounted on a straight mandrin. Once the distal end has reached the bladder, the half-sheath or "peel-away" sheath is unfolded in two halves and are withdrawn. After that, the mandrin will also be withdrawn and at the same time the catheter is completely inserted and the balloon inflated.

Rozanski et al. (1998) described an endoscopic catheterization technique using a short ureteroscope mounted on a 22F Foley catheter that has its tip cut out. Once the distal end of the endoscope reaches the bladder, the urethro-vesical catheter can be slid on it.

9.3.7 Suprapubic Cystostomy

If catheterization fails (including under endoscopic control), if the technical equipment available is modest, or if the maneuvers present a high risk of additional iatrogenic lesions, a suprapubic catheter is inserted for several weeks

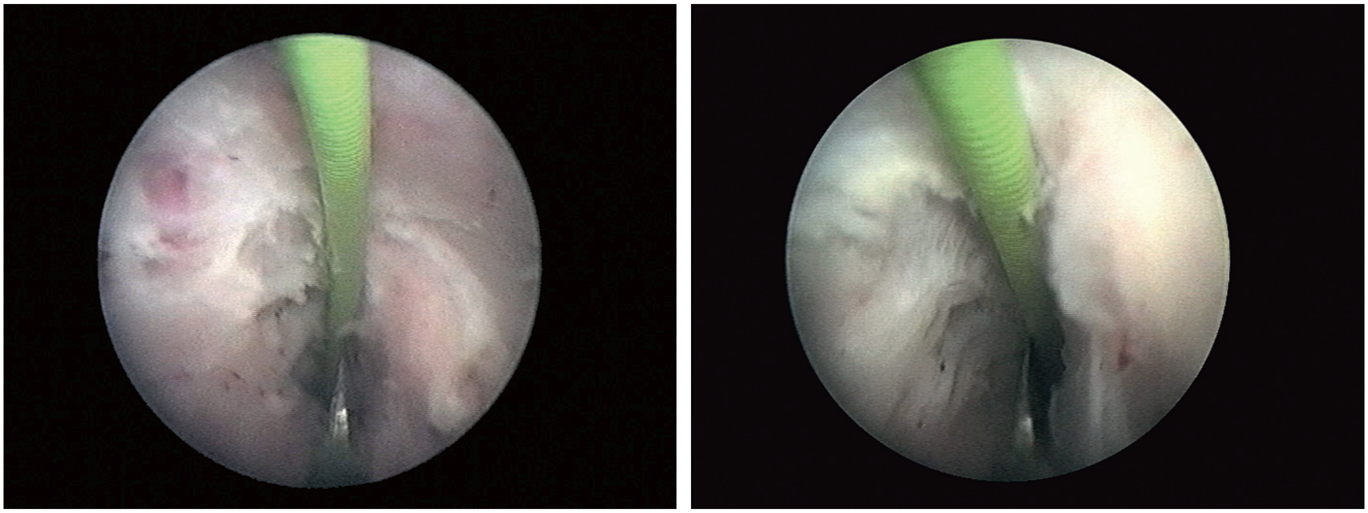

FIGURE 9.5 **Incision of the stenosis on the guidewire inserted into the bladder.**

(Awojobi and Lawani, 1984). After this time period, another endoscopic evaluation of the urethra is performed, followed by repair of the persistent lesions.

9.4 COMPLICATIONS

A very wide range of complications can occur during difficult catheterization, thus emphasizing once more the importance of this seemingly minor urologic gesture.

9.4.1 Urethro-Vesical Catheterization Failure

A minimal suprapubic cystostomy is performed when catheterization fails or is not recommended, leaving the urethro-prostatic pathology to be resolved at a later time (Villanueva and Hemstreet, 2008).

9.4.2 Septic Complications

Septic complications can range from simple urinary infections to periurethral abscesses, Fournier gangrene, or sepsis (Lopez Pacios et al., 2005). The most severe complications are favored by laborious and prolonged maneuvers, often complicated by perforation of the urethral wall and, sometimes, in poor aseptic conditions.

9.4.3 Urethrorrhagia

Urethrorrhagia is a consequence of iatrogenic injuries such as perforations and false passages, or it may be initiated by inflating the balloon in the urethral lumen or in the prostatic lodge. It occurs as a result of injury of the penile vascular structures or of the corpus cavernosum.

In most cases, this problem is solved by proper fitting of the urethro-vesical catheter and prophylactic antibiotherapy. If urethrorrhagia persists, pressure dressings can be applied around the penis. In some cases, urethrorrhagia can be dramatic, requiring blood transfusion.

9.4.4 Urethral Wall Lesions

Urethral wall lesions may vary from simple abrasions of the mucosa (Figs 9.6 and 9.7) to perforations with false passages (Figs 9.8 and 9.9). Management of these lesions is done by correctly inserting a catheter. If septa are present at the urethral level, they must be abolished by incision (Fig. 9.10) or resection.

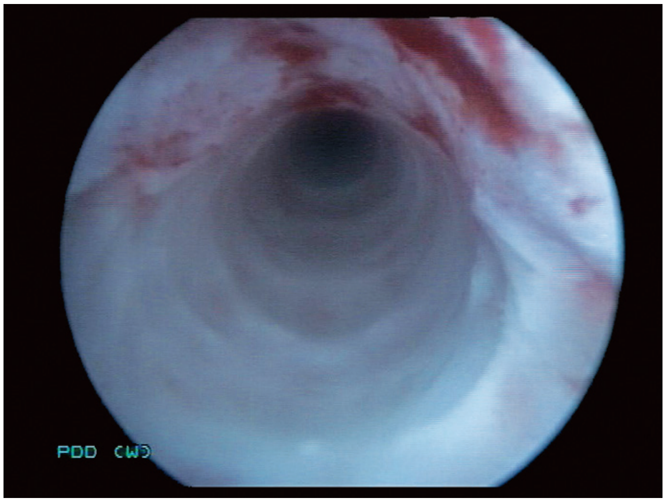

FIGURE 9.6 Abrasions of the urethral mucosa after urethro-vesical catheterization.

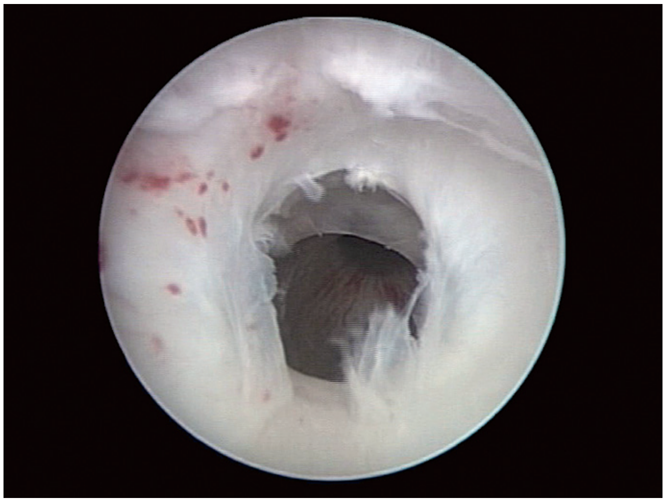

FIGURE 9.7 Mucosal lesions of the urethra in a patient with urethro-vesical stricture and difficult urethro-vesical catheterization.

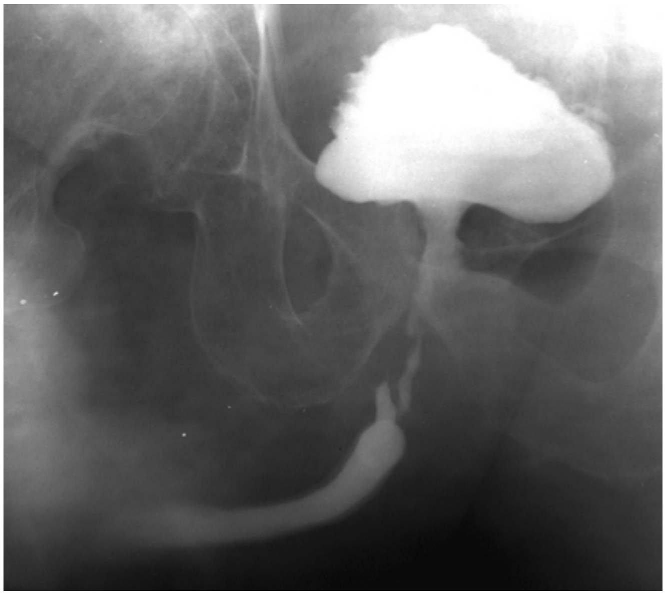

FIGURE 9.8 Iatrogenic urethral false passage underneath an urethral stricture, demonstrated by retrograde urethrography.

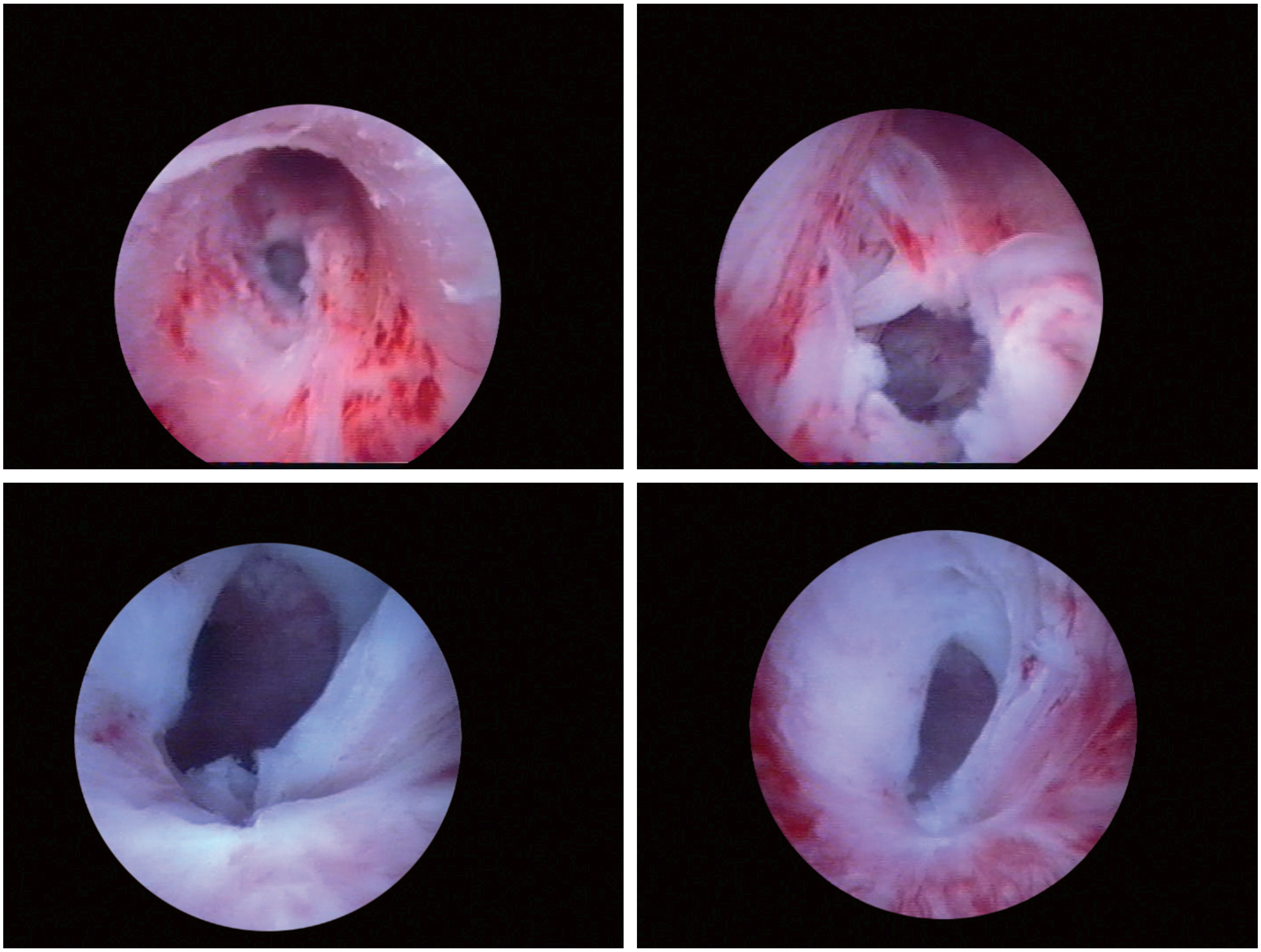

FIGURE 9.9 **Perforation of the urethral wall and false passages after an attempted urethro-vesical catheterization.**

Sometimes, urethral wall injuries developed after catheterization are identified late, after epithelialization, but with the possibility of persistence of some recesses (Fig. 9.11). If they are deep, they may need to be abolished by incision (Fig. 9.12) or resection. However, in the long-term, the most severe ones can initiate the process of spongiofibrosis, which can lead to the formation of urethral strictures.

9.4.5 Adjacent Organ Perforations

Perforations of the neighboring organs (e.g., the rectum) are rare complications, but of great severity, requiring emergency surgery (Villanueva and Hemstreet, 2008).

9.4.6 Urethral Strictures

Urethral strictures can occur because of damage to the urethral wall (Fig. 9.13), by initiating the spongiofibrosis process. Their treatment has been described in previous chapters.

9.4.7 Fistulae

Fistulae (the most common being urethrocutaneous or urethrovaginal) are late complications that occur after perforations and treatment is usually surgical.

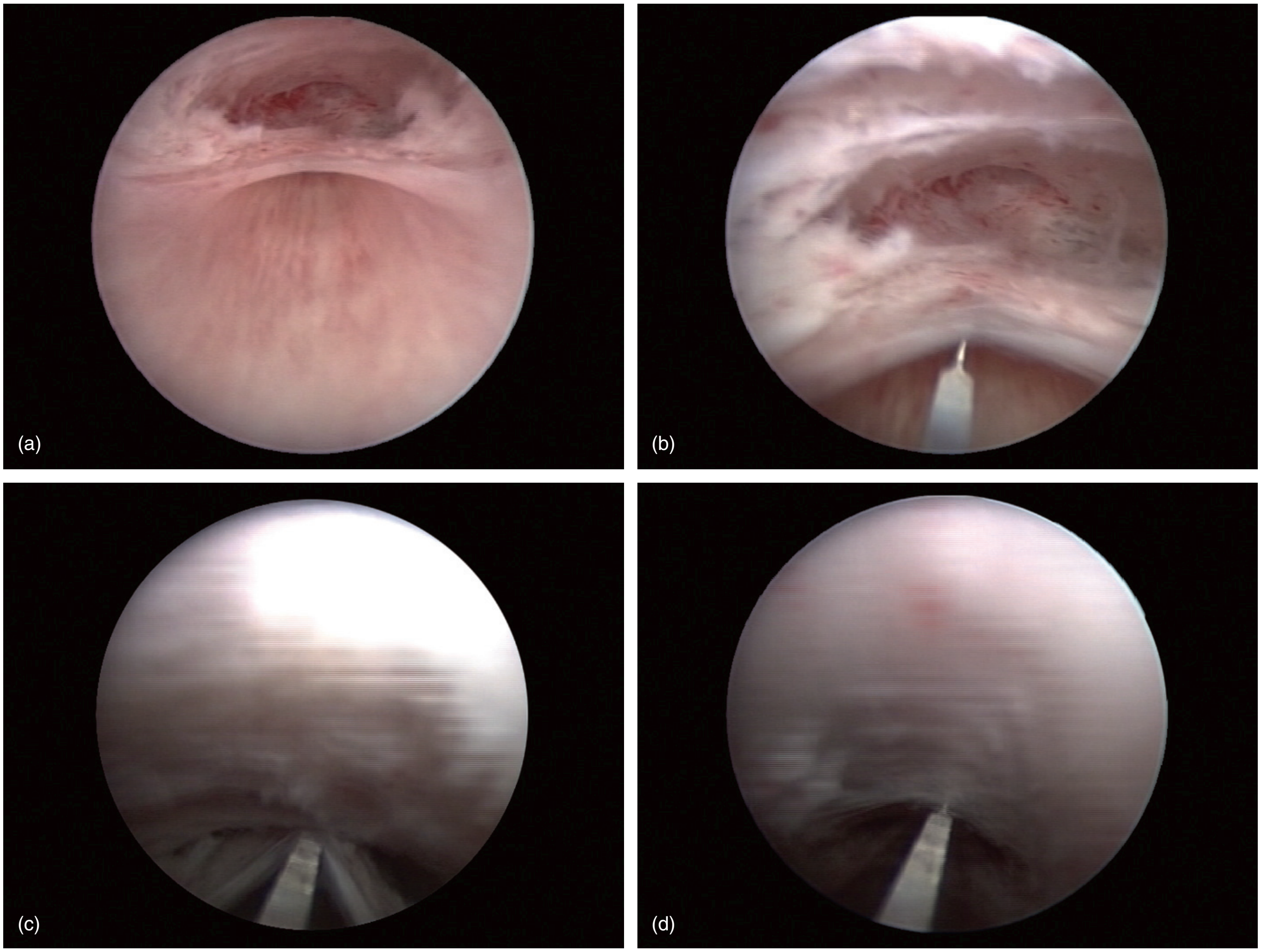

FIGURE 9.10 False passage generating a urethral septum (a) for which cold blade incision is performed (b, c, d).

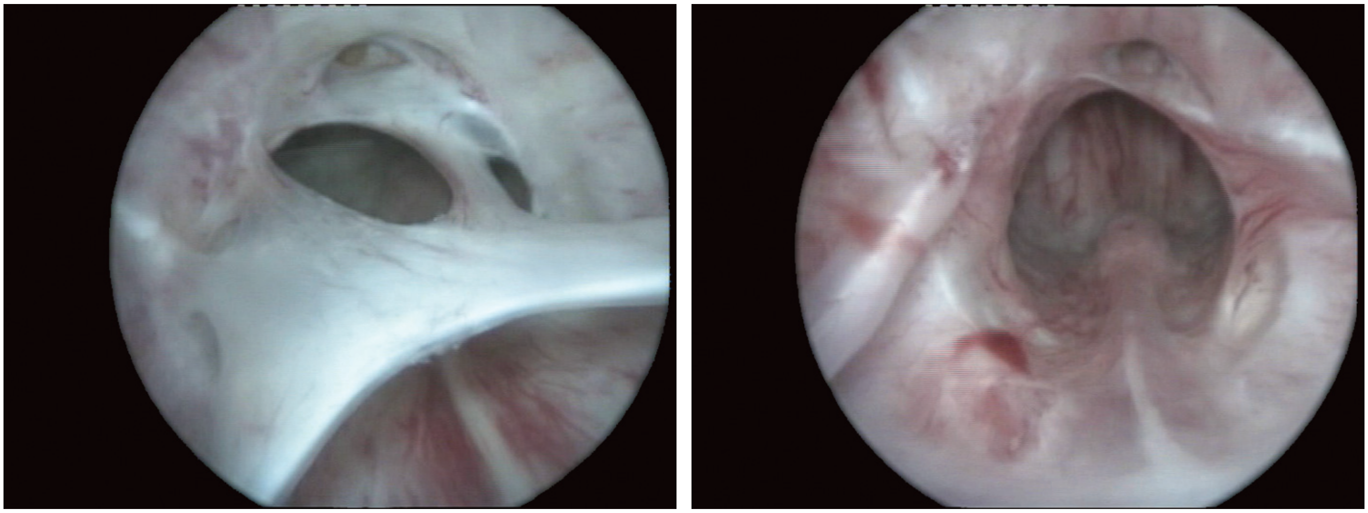

FIGURE 9.11 Old, epithelialized urethral false passages.

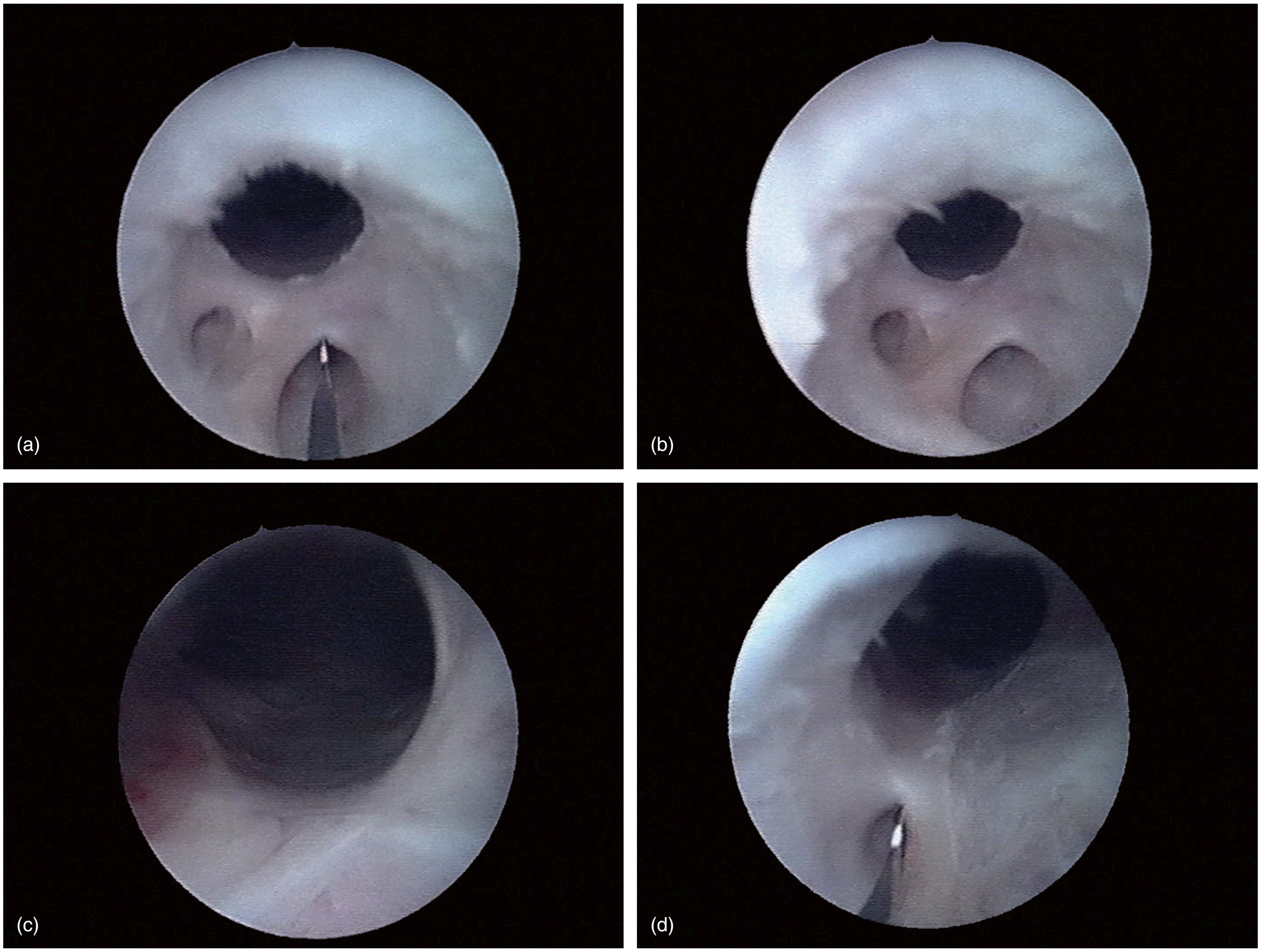

FIGURE 9.12 Stricture of the urethra and false underlying passages after an attempted urethro-vesical catheterization (a) abolished by cold blade incision (b, c) to obtain a wide lumen (d).

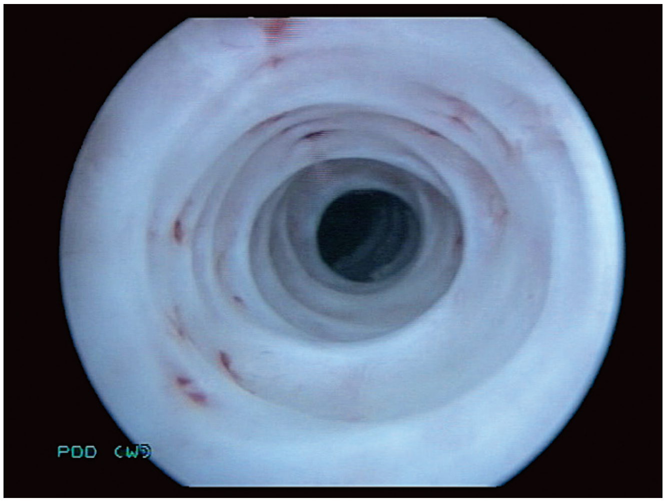

FIGURE 9.13 Multiple urethral strictures secondary to iatrogenic injury.

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CHAPTER

10

Endoscopic Treatment of Urinary Incontinence

Petrişor Geavlete, Cristian Persu, Răzvan Mulţescu, Bogdan Geavlete

10.1 GENERALITIES

The definition of urinary incontinence according to the International Continence Society is an involuntary loss of urine, regardless of the circumstances in which it occurs. This symptom can be caused by various medical conditions, and most of them benefit from effective treatment. Urinary incontinence has a major impact on quality of life and often represents a social problem. The economic implications of this condition range from high cost of care involved in patient management to less efficient individuals from a social standpoint. In many developed countries the total cost generated by patients suffering from urinary incontinence is higher than that imposed by many chronic conditions or more serious diseases.

Urinary incontinence is subdivided into several types, depending on the physiopathological mechanisms involved:

- Stress urinary incontinence is represented by the loss of urine during physical activities of varied intensities (lifting weights, coughing, laughing, etc.).
- Urgency urinary incontinence is based on neurological conditions that induce reflex contractions of the bladder muscle; this condition is also called overactive bladder syndrome.
- Mixed urinary incontinence occurs when the mechanisms involved in stress and urgency incontinence coexist.
- Enuresis is represented by the loss of urine during sleep; it is considered normal in small children, but it becomes a severe problem with increasing age.
- Overflow urinary incontinence (pseudoincontinence) is encountered in patients that have an inability to completely void their bladder during urination. This is a sign of lower urinary tract decompensation due to a subvesical obstruction; urine continuously accumulating in the bladder is discharged in small amounts when the accumulated volume exceeds the capacity of the bladder.

Treatment of stress urinary incontinence with injectable agents is a minimally invasive alternative that is commonly used; despite the numerous controversies it generates, it has been constantly evolving for over a century. The urodynamic definition of this form of incontinence states that the loss of urine occurs whenever bladder pressure exceeds the urethral pressure. The rationale behind this treatment is that any factor that may increase urethral pressure above the bladder pressure has the potential to be an effective treatment.

The objective of bulking agents is to restore urinary continence by creating a subvesical obstacle, thus preventing the free flow of urine in patients with impaired sphincter function (Fig. 10.1).

One problem consists in maintaining bladder detrusor pressure within acceptable limits, so that restoring continence is not associated with the occurrence of high urinary tract deterioration. Urodynamic studies have demonstrated that use of bulking agents does not increase detrusor pressure during voiding, despite a significant increase in urethral resistance during the filling phase. This can be explained by the urethra's ability to expand during voiding, without the involvement of extrinsic factors. Bulking agents have been used to treat stress urinary incontinence in women, with satisfactory results both in terms of effectiveness and in terms of safety and sustainability of results. The

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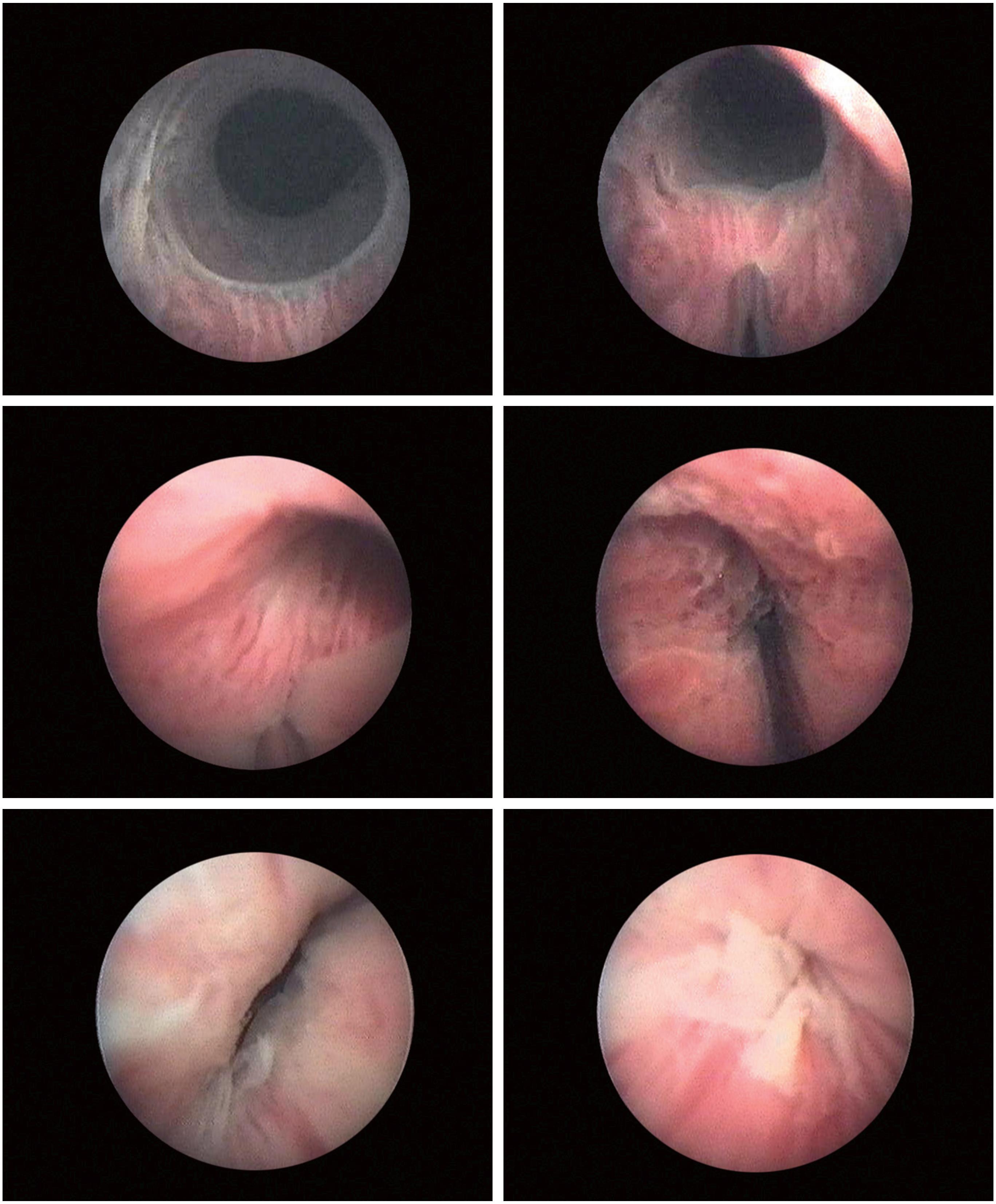

FIGURE 10.1 **Collagen injection in a patient with stress urinary incontinence resulting in a subvesical obstacle.**

recommendation also to use this type of treatment in male patients is supported by clinical data based on the use of new bulking agents with superior properties.

10.2 HISTORY

The first paper on periurethral injection of paraffin was published by R. Gersuny in Vienna at the end of the nineteenth century (Stoeckel, 1917). However, at the same time, Kelly and Dumm (1914) noticed a risk of embolism associated with the injection of a foreign body and noted that this treatment was successful only for a short period of time.

In 1938, Claes performed periurethral injections with sodium morrhuate and achieved tissue sclerosis and subsequent extrinsic compression of the urethra, relieving the patient's symptoms. The author reported formidable complications such as pulmonary infarction and cardiorespiratory arrest, which forced him to abandon the technique (Claes et al., 1989).

In 1955, Quackels performed periurethral paraffin injections without reporting complications. With more modest results of only 50% success rate, in 1963 Sachse treated a total of 31 patients by injecting another sclerosing material called Dondren. This was followed by a long series of authors reporting transurethral injection of sclerosing agents, most of them containing paraffin, with the aim of improving urinary continence. The first article describing the use of an endoscope for this type of procedure dates back to 1953. Submucosal injection of polytetrafluoroethylene (Teflon) was described in 1973 by Victor Politano (Politano et al., 1973), while the use of collagen dates back to 1989, followed shortly by the appearance of bulking agents containing silicone (Shortliffe et al., 1989).

10.3 INDICATIONS

Injection therapy represents a minimally invasive surgical procedure used in stress urinary incontinence with normal detrusor activity. This procedure is recommended in all cases where involuntary urine loss occurs as a direct result of sphincter incompetence. This technique can be used to treat male patients with urinary incontinence secondary to radical prostatectomy, transurethral resection of prostate adenoma or transvesical adenectomy, or whenever urethral sphincter injury is suspected (pelvic trauma, spinal injuries, etc.). Past radiation therapy induces modifications in the urothelium, which may lead to injuries when the bulking agent is injected. At the same time, vascular changes secondary to radiotherapy slow down the interaction between the bulking agent and the host tissue, thereby decreasing the sustainability of the outcomes.

In female patients, the "classic" recommendation is an incompetent sphincter; however, data also show favorable results in cases of incontinence through urethral hypermobility (Faerber, 1995). In a study published in 2001, Bent et al. (2001) suggested that the recommendation for injectable treatment in women should be extended to all forms of stress urinary incontinence, underlining the fact that patients with urethral hypermobility present a decrease in the transmission of abdominal pressure to the urethra, and that injectable bulking agents may substitute this difference.

If the patient evaluation protocol establishes the diagnosis of mixed urinary incontinence, with sphincterian incompetence as the dominant component, injection therapy may be an option, although the available data are not sufficient to support this recommendation.

Injection therapy is an option to be considered in patients with associated conditions that would contraindicate laborious surgery, or in patients who refuse such interventions. Injectable agents may also be used, with good results, in neurological incontinent patients; however, the preoperative evaluation has to completely exclude detrusor hyperactivity due to the fact that it may be exacerbated postoperatively, thereby generating high bladder pressures which are dangerous for the upper urinary tract.

Another recommendation is represented by the treatment of geriatric incontinence because it does not require a special preparation of the patient and the complication rates are low.

While the current available data place injection therapy as a first-line minimally invasive surgical treatment for urinary incontinence in women, existing clinical studies show reduced effectiveness of this treatment in male patients; thereby, current recommendations (level of evidence 3, grade of recommendation C) grant priority to more invasive procedures, such as urethral slings or artificial sphincters. Injection therapy is recommended in male patients in whom invasive techniques are contraindicated due to associated comorbidities.

In children, sphincter incompetence is usually caused by congenital abnormalities or by other factors that alter the normal development of the fetus. The recommendation for injection therapy in these patients is conditioned by the presence of a normal bladder capacity, with normal detrusor function and no anatomic abnormalities.

A particular recommendation of bulking agents is represented by patients who underwent highly invasive procedures as first-line treatment, with unsatisfactory results. Although it is recognized that the chances of success are lower than in the case of a patient who has not undergone incontinence surgery, injection therapy may be recommended in these cases.

10.4 CLASSIFICATION OF INJECTABLE AGENTS

An ideal injectable agent should be easy to use, inexpensive, durable, with good biocompatibility, hypoallergenic, and nonimmunogenic. Moreover, in order to prevent spontaneous migration, injectable particles must have a diameter of over 80 μm. Modern urologists have a variety of bulking agents at their disposal, each promising features that confer a decisive advantage. However, it must be remembered that most are relatively new substances, whose mechanism of action is not fully understood and that have not been validated by undeniable clinical evidence. The experience gained so far entitles us to believe that technology has evolved enough in order to produce a bulking agent with ideal properties, although it is not yet available. Some substances have not been validated by the national authorities, so their use is frequently experimental. The modern clinical classification divides the bulking agents into resorbable and nonresorbable. Other classification criteria are the status of approval by the FDA, the synthetic or biological nature of the substance, size of the molecules, etc.

10.4.1 Resorbable Injectable Agents

Resorbable injectable agents are biological products, possibly conditioned in the laboratory to be used as injectable agents. These substances have been used in medicine for a long period of time, thus their adverse experiences are better known. The main advantage is superior biocompatibility. However, with the technological advances, synthetic molecules tend to overcome the biological ones qualitatively. The main biological substances used are bovine collagen, autologous fat, and protein polymers.

10.4.1.1 Bovine Collagen (GAX)

Bovine collagen is one of the earliest biocompatible materials used in medicine, finding various uses over time: suture material, hemostatic agent, etc. It is among the first substances used in the injection treatment of urinary incontinence. However, its price remains high due to the complex process by which it is produced, presently being more expensive than Teflon (Geavlete, 1999).

The main advantage of collagen is that it does not form granulomas and does not migrate from the injection site. However, intradermal testing is mandatory prior to periurethral injection. Collagen is well tolerated, and collagen injections have been reported in pregnant women (Geavlete et al., 2003).

GAX is marketed as a highly purified sterile solution obtained from bovine dermal collagen; it is bonded in 0.0075% glutaraldehyde and suspended in 0.3% lidocaine and saline solution. It is a biodegradable material characterized by a variable degree of resorbtion (DeLustro et al., 1991). It contains a minimum of 95% type I collagen and 5% type III collagen obtained through selective hydrolysis of the amino nonhelicoidale terminal group and carboxy-terminal segments, a method that yields low antigenicity. GAX collagen is biocompatible, biodegradable, and does not cause a foreign body reaction at the injection site; however, it causes a local inflammatory reaction. Its volume does not decrease immediately after injection due to the formation of a compact fibrous structure that is integrated into the connective tissue and that also forms a matrix where new collagen is deposited (Geavlete, 1999). Collagen degradation begins 12 weeks after injection, while complete degradation occurs after 19 months; this period of time is enough for the injected material to transform into connective tissue, which also explains the particular effectiveness of this treatment (Canning et al., 1988).

There is no consensus on the amount of substance that needs to be injected; data in the literature range from 3 cm^3 to 60 cm^3 in the course of one procedure.

10.4.1.2 Autologous Fat

The first injections of autologous material for the treatment of urinary incontinence were made with heparinized blood, which offered very good immediate results; however, it was quickly absorbed by the body so its effectiveness was compromised (Appell, 1994).

Autologous fat has been used in medicine for over a century, mainly to correct defects of the dermis, or for cosmetic surgery. It has the advantage of biocompatibility and that it is easily obtained by liposuction. A transurethral technique of autologous fat injection was described in 1989 by Santiago González de Garibay (Santiago González de Garibay et al., 1989).

Most authors inject 20 cm^3 of fat in one procedure, transurethrally, or periurethrally. Experimental studies have shown development of areas of neovascularization at the periphery of the injected fat, while fibrosis tissue gradually forms in the central area (Santarosa and Blaivas, 1994).

10.4.2 Nonresorbable Injectable Agents

Nonresorbable agents are synthetic products, specifically developed for the injectable treatment of urinary incontinence or adapted for this purpose. As with any modern substance, synthetic agents promise a range of advantages over biological agents, but their use is often limited by the mode of action or by their incompletely known adverse reactions. However, there is currently an increase in the use of nonresorbable agents for the treatment of urinary incontinence.

10.4.2.1 Polytetrafluoroethylene (PTFE, Teflon©)

Teflon consists of microparticles with diameters between 1 μm and 100 μm, more than 90% of particles having a diameter below 40 μm. The macroscopic aspect is of a white paste with very viscous consistency. The first urologic applications were for treating vesicoureteral reflux and date back to the 1970s, shortly after the discovery of Teflon (Berg, 1973).

After transurethral injection with the help of the dedicated device, this synthetic paste consisting of micropolymers will trigger a fibroblast reaction, which locks the Teflon particles in the periurethral tissues, ensuring long-lasting results.

However, due to the existence of some reported cases of spontaneous migration of these particles, the FDA denied the use of Teflon for the treatment of urinary incontinence. Despite this, Teflon is still among the most commonly used injectable agents in Europe and Asia (Appell, 1990).

10.4.2.2 Durasphere

This is a synthetic substance approved by the FDA in 1999 for the injectable treatment of urinary incontinence, after a history of 30 years of being used in the composition of heart valves. The microscopic aspect is of 212–500 μm zirconium microspheres coated with a layer of carbon. Durasphere solution is marketed as a gray, viscous solution. The kit includes a sterile syringe with the injectable substance, 18–20G injection needles similar those used in spinal anesthesia, and the product label. It can be injected through a transurethral or periurethral approach.

Due to the high viscosity of the substance, the injection of Durasphere is technically more complex. The company that manufactures the product has introduced a new version of the agent, marketed as Durasphere EXP®, that attempts to address the inconveniences of the original version.

The main advantages of this agent are the lack of immunological reactions and the mild inflammatory reactions, thus eliminating the need for intradermal testing or temperature-controlled storage rooms (Lightner et al., 2001). The substance has a relatively high cost, but the manufacturer claims that the microspheres remain effective for a period of at least 2 years.

10.4.2.3 Ethylene Vinyl Alcohol (EVOH, Tegress®)

This is the newest substance used in the injectable treatment of stress urinary incontinence, and promises to solve some of the problems associated with bulking agents. It is a copolymer dissolved in dimethyl sulfoxide (DMSO); immediately after injection, the substance decomposes to form a mass with a spongy aspect, adhering to the surrounding tissues. This process takes approximately 60 s after the substance comes in contact with the blood at body temperature, the volume of the molecules remaining constant after the injection.

The kit contains a vial with 3 mL solution, a sterile syringe, and a 25-gauge needle. The substance was approved by the FDA in 2004, but only for transurethral injection (US Food and Drug Administration, 2004). The injection technique described by the manufacturer recommends injecting 1 mL substance over 1 min, followed by 1 min pause. It is thus considered that each injected milliliter will have time to be transformed and adhere to the adjacent tissues, considerably increasing the effectiveness of this treatment.

An acute inflammatory response occurs in the first 3 months postoperatively, which gradually becomes localized. There are no known cases of migration into the blood stream and no other late systemic side effects.

10.4.2.4 Silicone Polymers (Macroplastique, Bioplastique)

Silicone particles suspended in a solution of polyvinylpyrrolidone (33% of the total volume is occupied by the silicone particles), marketed as Macroplastique or Bioplastique, are microscopic entities with a constant volume (100–600 μm) that is large enough to make spontaneous migration unlikely. Because it is a substance with a very good biocompatibility, tests prior to the procedure are not required (Koelbl et al., 1998). From existing experience there is a very low rate of complications and adverse effects (Henly et al., 1995). The disadvantages of this substance are related to its very high viscosity and the high cost of the procedure (Mourad, 2003).

10.4.2.5 Hyaluronic Acid (Zuidex)

Zuidex is a recently developed bulking agent, consisting of hyaluronic acid and polymerized dextran, with good biocompatibility and low risk of undesirable immune reactions.

Hyaluronic acid is synthesized by the human body, having the role of reducing friction in the joints and to stabilize tissue. The synthetic product, developed in 1998, was used to treat wounds and vesicoureteral reflux, with the advantage of avoiding potential side effects that are seen with the use of animal derived substances. Hyaluronic acid is rapidly absorbed into the circulation, so it is used only as a transport agent for the dextran molecules that are slowly biodegradable.

The substance used for the treatment of urinary incontinence is comprised of molecules weighing between 8 and 23 million Da, dissolved in saline solution. After injection, the substance is organized as a matrix upon which deposits of collagen and fibroblast populations are formed. It has the advantage of very slow absorption into the body, promising lasting results.

The injection requires a special device called an implacer, which is provided together with the substance and which allows submucosal administration.

10.4.2.6 Bulkamid

The advantages of this synthetic substance are a neutral pH, the absence of toxic or allergic reactions, a very good safety profile, and stability over time. It is a gel composed of water (97.5%) and a nonabsorbable synthetic polymer (2.5%) that maintains its structure and shape after injection.

It requires a special disposable device provided together with the injectable substance, composed of a cystoscope and an injection needle. The application is performed under visual control with a 23G gauge needle, which allows for very precise administration with minimal tissue damage. However, this device substantially increases the cost of the procedure.

10.4.2.7 Bioglass

Bioglass is an inert mixture of calcium oxide, silicone, and sodium oxide, which showed good biocompatibility in animal tests. After administration, the substance was embedded into the surrounding tissues, increasing their volume (Walker et al., 1992). Currently there are no clinical data on the use of this substance in humans.

10.4.2.8 Calcium Hydroxyapatite

Calcium hydroxyapatite is a synthetic material identical to the substance in teeth and bones. It is marketed as an aqueous gel containing hydroxyapatite microspheres, with good biocompatibility and producing low intensity inflammatory reactions. The particles do not migrate spontaneously because of their size, ranging between 75 μm and 120 μm. The principle of action is based on the increase in the volume of the tissue into which it is administered by attracting collagen. After injection, the substance can be observed on simple radiography or at ultrasound, making it easy to monitor in the follow-up period. Atmospheric air degrades the substance, which is why exposure should be avoided during the procedure.

10.4.2.9 Cellular Therapy by Injection of Autologous Chondrocytes

Cell engineering is a field that has progressed steadily over the last few decades, currently reaching a level of development that enables practical applications in human patients. By combining transurethral injection therapy principles with cell engineering, which would allow for morphological and functional regeneration of the damaged urinary sphincter, injection of autologous chondrocytes promises to solve a number of problems currently faced by physicians who seek the ideal treatment for urinary incontinence through sphincter incompetence.

The rationale of this treatment is perfect biocompatibility, long lasting results, a simple injection technique, and the fact that the manipulation of cell masses is now also possible *in vivo*. Chondrocytes are harvested from the patient's auricular region, the cell population is expanded through cell culture techniques, and the obtained mass is combined with a polymer that will serve as a vehicle for intraurethral injection (Atala et al., 1993).

Very few clinical data are available regarding the use of this technique in human patients but many clinical trials are currently under way.

10.4.2.10 Cellular Therapy Through Injection of Autologous Fibroblasts and Myoblasts

In recent years the use of myoblasts or fibroblasts, harvested from the biceps muscle, has been proposed, using collagen as a vehicle of delivery to the sphincter region (Yokoyama et al., 2000). This technique promises striated sphincter regeneration through the differentiation of the injected cells into smooth and striated muscle tissue. An alternative technique uses cells harvested from the detrusor muscle; this method is used in animal models for the experimental treatment of vesicoureteral reflux. Thus, procedures performed on rats have shown a significant increase in muscular activity after injection of myoblasts (Peyromaure et al., 2004).

In a study conducted in 2006, Yiou experimented with the use of satellite cells of the striated sphincter, which are deemed to have the ability to regenerate striated muscle, which composes the sphincter. The results obtained in rats showed a significant increase in striated sphincter activity after satellite cell injection. The main advantage of this technique is the facile harvesting and preparation of the cellular mass, which makes it unnecessary to use laboratories specialized in cell engineering. The author suggests that the injection of satellite cells triggers the synthesis of neurotrophic factors that may restore striated sphincter function by generating new nerve connections that replace the damaged ones (Zini et al., 2006).

A series of clinical trials and research projects are currently under way that aim to improve the quality of tissue regeneration techniques as well as to monitor clinical outcomes.

Until the results of clinical trials are revealed, this method has to face many critical opinions, which raise the issues of the very high cost of handling cell populations and of confidentiality, which cannot be maintained while the departments involved in this process are part of different institutions. Perhaps the most serious problem is the risk of injecting cells harvested from one patient into a different patient, with all the dramatic consequences that may result.

Clinical trials continuous research carried out in laboratories will establish the role of cell therapy in the treatment of stress urinary incontinence in the near future.

10.5 TRANSURETHRAL INJECTION TECHNIQUE

10.5.1 Anesthesia

The injection of various bulking agents is performed under local or spinal anesthesia. Regional anesthesia is recommended in male patients, while in female patients most interventions can be performed under local anesthesia. Regardless of the technique, the injection procedure can be performed in an outpatient regime.

10.5.2 Patient Positioning

The injection is performed with the patient in the classical lithotomy position. Patient preparation, draping, and the surgical instruments are similar to those used in other endoscopic procedures.

10.5.3 Urethral Approach

The approach may be anterograde through suprapubic bladder puncture, which is rarely used, or it may be retrograde. In the latter case, the injection can be performed using a transurethral, periurethral, or transperineal approach. The endoscopic transurethral technique is the most commonly used, regardless of patient gender.

A cystoscope with 0–30° optics is used for the transurethral method. The needle, through which the agent is injected, is inserted into the working channel.

10.5.4 Substance Injection

Although there is still no standardized technique, injection therapy is based on several basic principles. This will aim to minimize urethral mucosa lesions while ensuring an optimal injection plane. The injection is performed with reduced velocity and under continuous visual control; the cystoscope is maintained below the agent inoculation area.

The injection site is still a matter of controversy; data in the literature describe various sites between the bladder neck and the segment located distal to the sphincter. In principle, in male patients, the injection is performed distal to the external sphincter (Fig. 10.2).

Although the available data in the literature are not enough to make a recommendation, it is accepted that injections performed in the bulbar urethra yield poor results due to its caliber and low compliance, while those performed

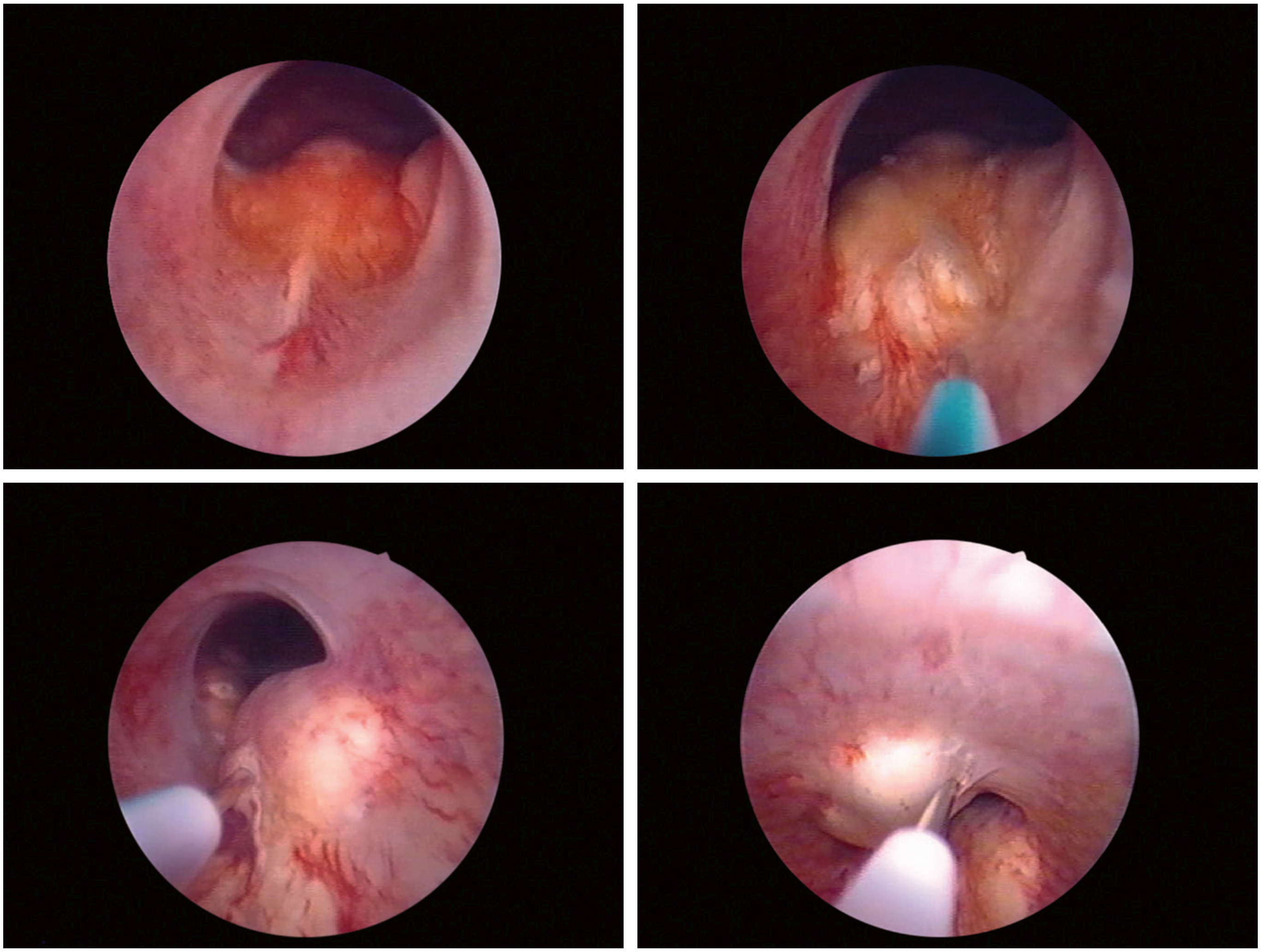

FIGURE 10.2 Collagen injections in a male patient, in the area immediately underlying the external sphincter.

in the sphincter yield poor results due to its spasticity and incompetence (Appell, 1994). In female patients, the injection site is represented by the bladder neck (Fig. 10.3).

At the same time, there are no recommendations on the precise puncture site along the circumference of the urethra, but most authors perform injections at 3 and 9 o'clock (Fig. 10.4), using either a transurethral or periurethral technique (Persu et al., 2007).

The bulking agent is injected in the urethral wall, creating an area that protrudes into the urethral lumen (Fig. 10.5), until a complete urethral obstruction is achieved at the injection site (Fig. 10.6).

Although all authors view them as the main variables responsible for the success of the treatment, the depth of the injection and the amount of agent used are not yet standardized. The number of injections should be limited in order to reduce substance extravasation through the orifices created by injections nearby (Fig. 10.7). Thus, the premises for faster healing are created (Kylmala et al., 2003). Also, there are no data supported by clinical trials regarding the number of repeat procedures required before declaring treatment failure.

10.5.5 Postoperative Management

Postoperatively, the patient can be monitored without a urethro-vesical catheter, or a small caliber (12–14F) Foley catheter may be placed. Alternatively, suprapubic drainage can be ensured by minimal cystostomy. Antibiotic treatment should be started 2–3 days before the intervention.

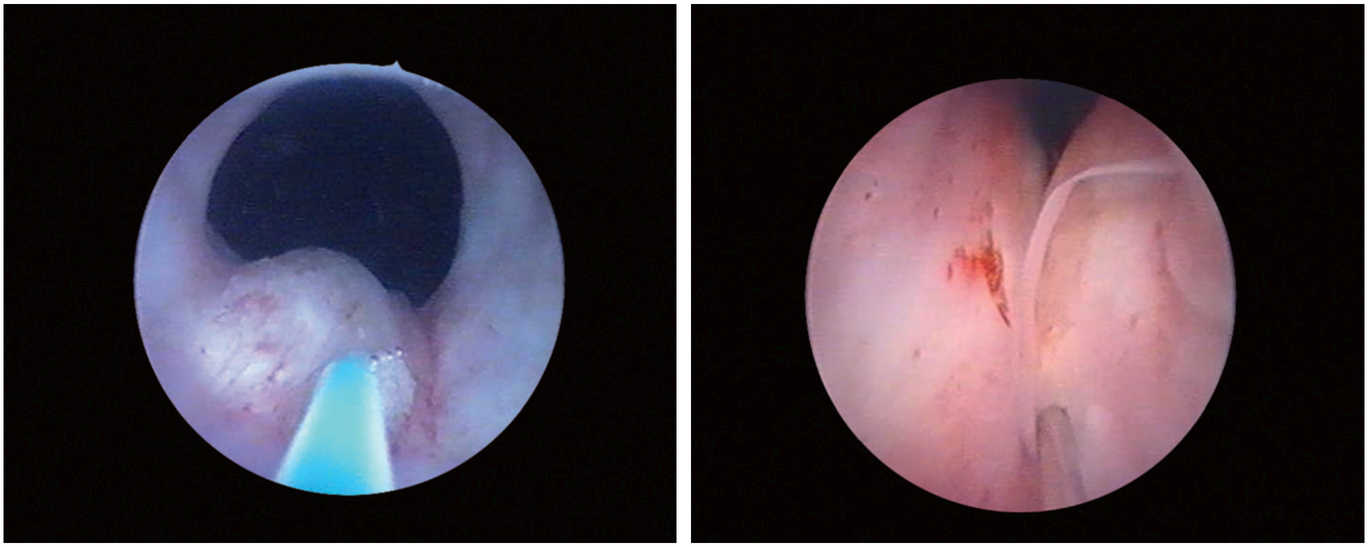

FIGURE 10.3 Collagen injection in a female patient, in the bladder neck.

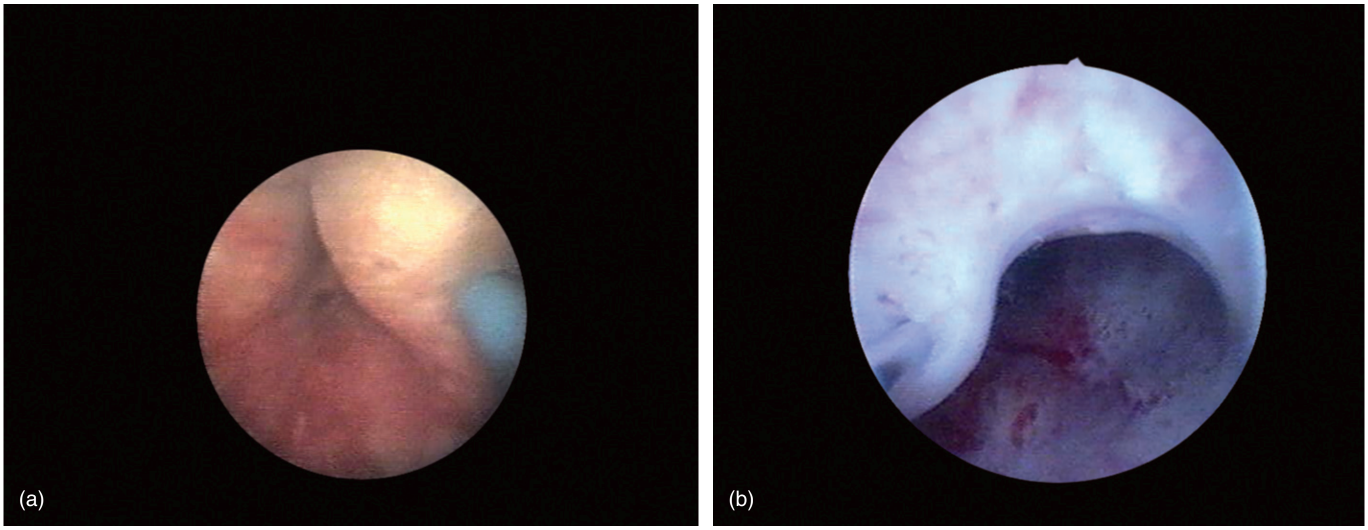

FIGURE 10.4 Collagen injection at (a) 3 o'clock and (b) 9 o'clock.

10.5.6 Other Injection Methods

Periurethral injections are recommended for female patients, due to the extremely facile detection of the proximal urethra and because this surgical approach is associated with a lower rate of hemorrhagic complications compared with the transurethral technique (O'Connell and McGuire, 1995). Usually, small caliber needles with sufficient length are used, and the maneuver is carried out under endoscopic or transvaginal ultrasound guidance. The injection is performed at 4 and 6 o'clock, and the endoscopic image obtained is comparable to that of the prostate lateral lobes. The learning curve is significantly longer than in the case of the transurethral technique.

Transperineal injection, recommended in men, is more rarely used due to the complexity of the procedure and to the poor results it yields. In children, the technical principles are the same, the main difference being the smaller caliber of the instruments (Cole et al., 2003).

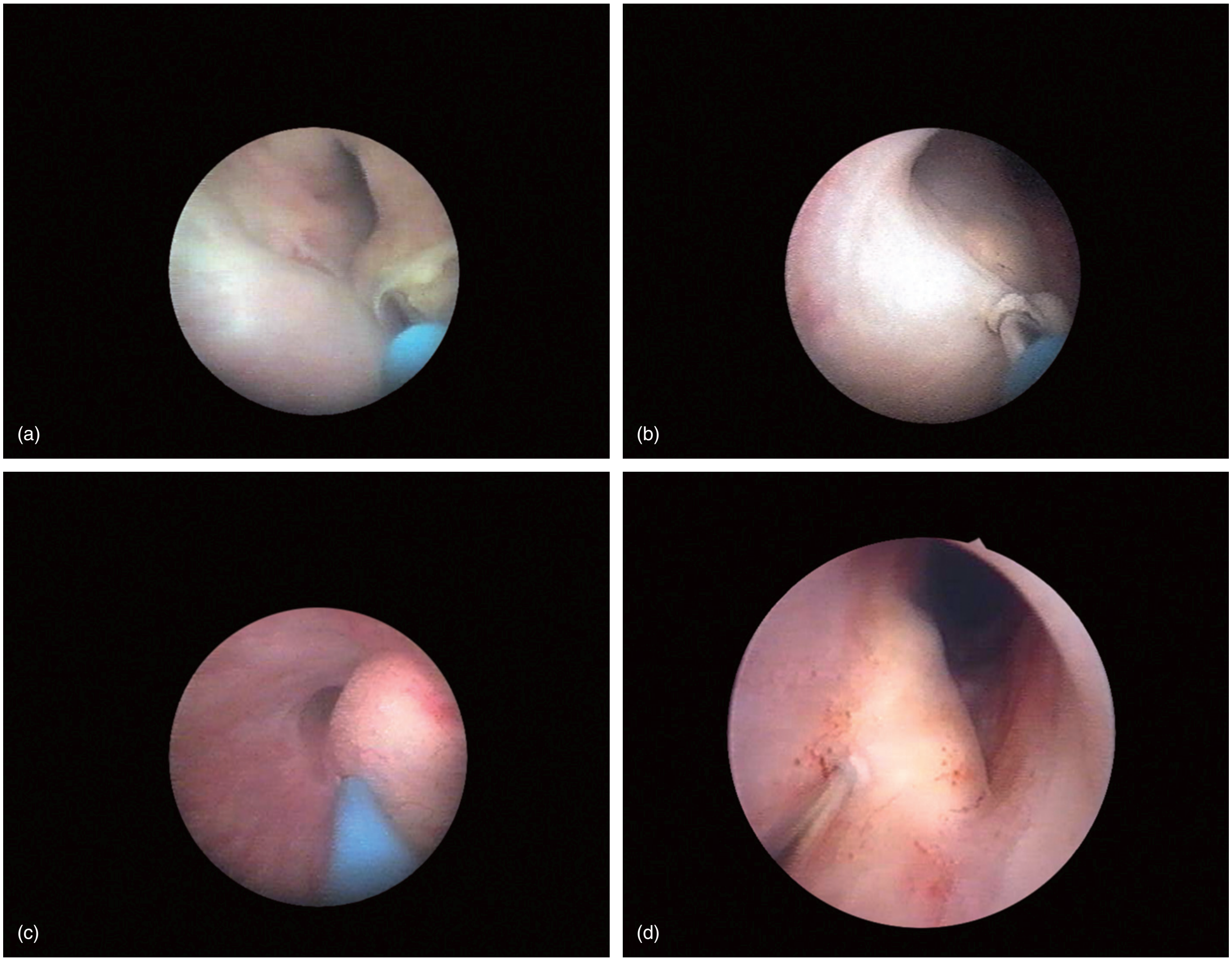

FIGURE 10.5 Injection of collagen in a male patient (a, b) and a female patient (c, d), forming a protrusion into the lumen.

10.6 COMPLICATIONS

In general, the complications of injection therapy for urinary incontinence are rare and not life-threatening. This is one of the main arguments for those who prefer injection therapy as a first-line surgical treatment, coupled with the fact that the failure of an injection procedure does not usually contraindicate other, more invasive treatments.

Some of most common complications reported in the literature are urinary tract infections, acute urine retention, dysuria or hematuria, all of which are transitory.

- Infectious complications – these can range from simple urinary infections to periurethral abscesses or even Fournier gangrene. Sweat reported abscesses with sterile content, which required drainage, but which did not generate any later complications (Sweat and Lightner, 1999).
- Complete urine retention – may require a temporary urethro-vesical stent or a minimal suprapubic cystostomy.
- Irritative symptoms – occur in approximately 20% of patients, but in most cases the symptoms resolve spontaneously within a few days (Schulman et al., 1984). Some authors report *de novo* detrusor hyperactivity occurring at variable intervals after injection therapy; however, the connection could not be clearly demonstrated, and incomplete preoperative assessment was often pointed out (Stothers, 1998).
- Bleeding – urethral mucosal perforation during the procedure, with the extravasation of the agent, is sometimes accompanied by significant bleeding. However, this complication does not require specific treatment, only

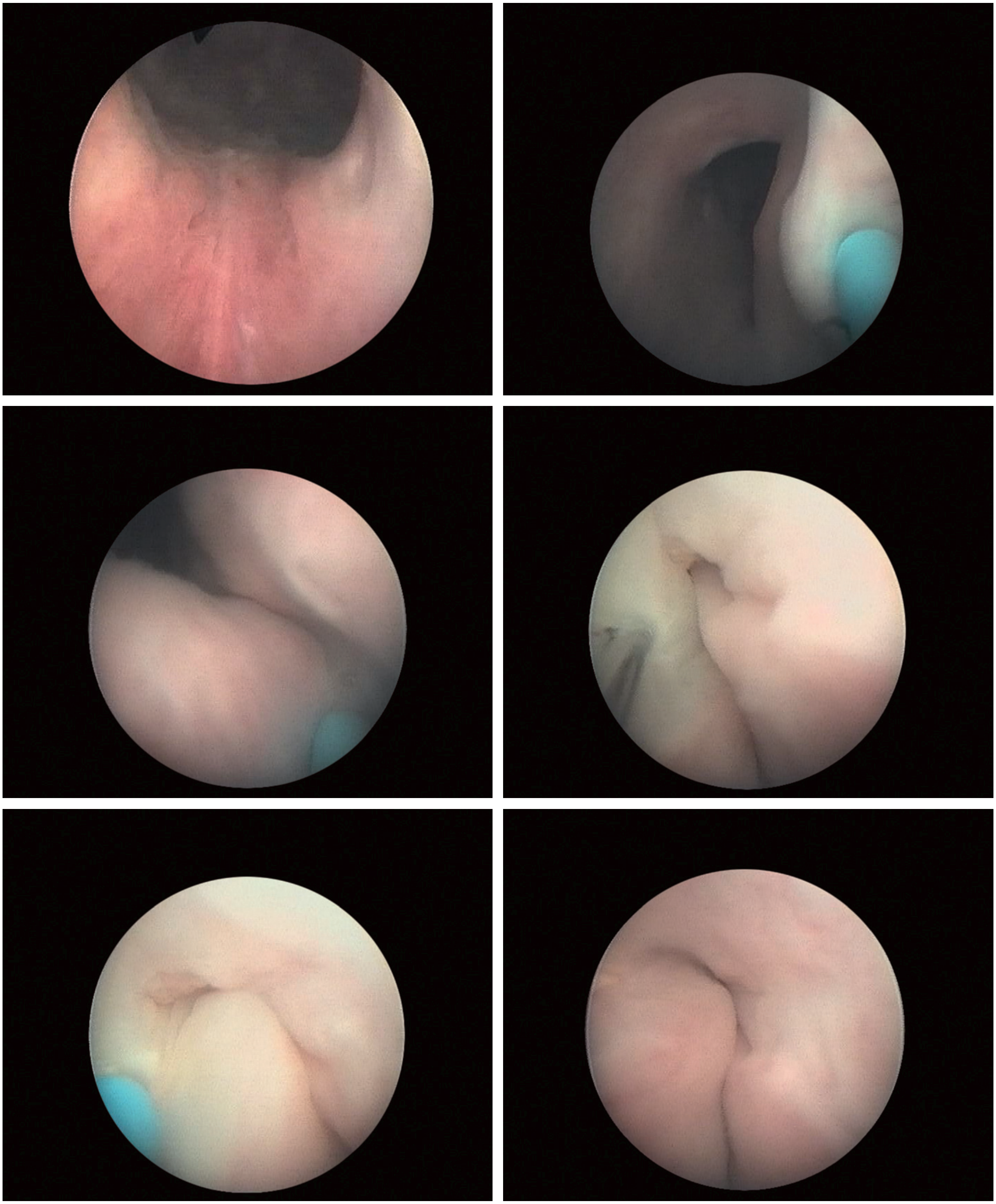

FIGURE 10.6 **Progressive collagen injection directly beneath the sphincter until the lumen is completely obstructed.**

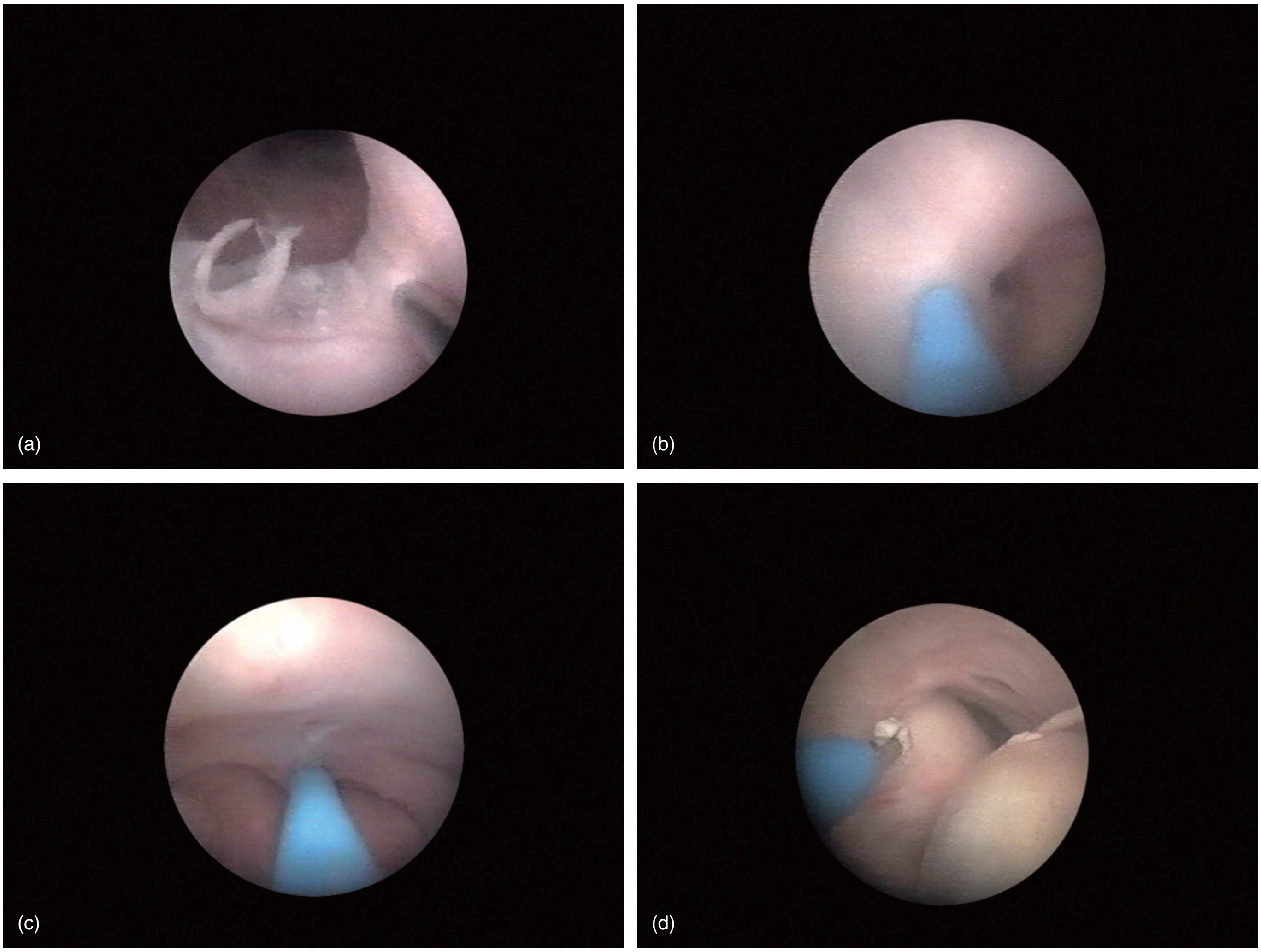

FIGURE 10.7 **Multiple punctures made in order to inject collagen (a–c), with substance extravasation (d).**

avoiding the bleeding area when performing further injections. A urethral catheter is occasionally necessary in order to control the bleeding.

- Allergic reactions – when using collagen, preoperative testing of the patient is recommended by intradermal injections, this substance being a potential allergen. Stothers and Goldenberg (1998) reported hypersensitivity reactions to collagen in a group of patients who underwent periurethral injection with bovine collagen.
- Bulking agent migration – the most frequent complication associated with injection of synthetic substances (Teflon, silicone, Durasphere) is local or systemic migration, usually without occurrence of other reactions. However, the literature reports several cases of pulmonary infarction in patients who had previously received transurethral Teflon injections, although the substance migration into the pulmonary territory could not be demonstrated (Claes et al., 1989). However, there have been reports of local or distal granulomatous reactions after transurethral injection of Teflon.

10.7 RESULTS

The first study showing the results of injection therapy dates back to 1938, when Murless (1938) reported the results of injecting sodium morrhuate in 20 patients with stress incontinence, describing favorable results in 17 cases.

There are now many reports on the use of injection therapy in urinary incontinence. However, most reports are based on studies performed on small groups of patients and which are single-center studies, without comparing the substance used to other similar bulking agents or to placebo (evidence level 4). The follow-up period is less than 1 year in most cases, and the patient enrollment period is very short. Some studies have examined the effectiveness of injectable agents in patients selected according to certain criteria, without a control group. However, there are few studies comparing injectable agents to other modern therapeutic techniques.

Although there have been attempts to standardize the urodynamic parameters of stress urinary incontinence and urethral hypermobility, most authors use their own definitions for these notions, thus creating an overlap of concepts between different reports. The lack of a standardized technique, the lack of validated quality of life questionnaires, as well as the different ways to define treatment success or failure make the comparative study of these data almost impossible (Pickard et al., 2003). A recent study shows promising results for paraurethral injections of silicone microballoons in women with SUI. However, as the technique was performed on 11 patients who were followed up for 18 months, no general conclusions can be drawn (Miyaoka et al., 2010).

In accordance with the principles of evidence-based medicine, all of these data can only represent a grade C recommendation based on retrospective case-control studies without control groups, or on the personal opinion of the authors. This level of evidence is insufficient to make recommendations in clinical practice guidelines. However, there are several recent studies that meet all modern rigors of scientific research, and that may generate grade A or B recommendations. Unfortunately, they only answer a limited number of issues, being unable to classify injection therapy as an indispensable technique in the treatment of stress urinary incontinence.

The common points of the available studies seem to be the low degree of difficulty for this type of procedure, the relatively inexpensive price, the low rate of complications and side effects, associated with good or very good immediate results, but with a very low rate of curing patients over the long term. Due to all these factors, injection therapy can only be regarded as an optional treatment.

An overview of the clinical evidence available today leads to the conclusion that, at the moment, a bulking agent that has the potential of becoming the gold standard treatment in urinary incontinence does not exist. The overall analysis of results shows that patients with stress incontinence are cured in about 25% of cases, improvements are noted in 50% of cases, while 25% are considered treatment failures. It is accepted that the results are not definitive, and that reinjection is necessary and regarded as a normal stage of treatment (Keegan et al., 2007). An overall evaluation of existing data shows that injection therapy results are better if the recommendation is for sphincter incompetence. It has been noted that this technique yields better results if it is the first surgical intervention for incontinence and that the success rate decreases if injection therapy is performed following the failure of other procedures. Although figures vary greatly depending on the design of each study, we notice better results from injection therapy in women (Kerr, 2005). Although extensive experience in the use of bovine collagen for the treatment of urinary incontinence is available worldwide, the published results are very different (Persu et al., 2009). It is considered that after the first injection, incontinence is corrected in 30% of cases, and that the following two injections may improve outcomes even more (Gorton et al., 1999). Subsequent procedures did not significantly improve the success rate. In all cases, incontinence gradually recurs after a median of 18 months of absence of symptoms (Corcos and Fournier, 1999).

A study using a group of 322 male patients with urinary incontinence by sphincter incompetence (Fig. 10.8) showed that optimal results are achieved after one to three administrations, noting that there was no correlation between the initial severity of symptoms or the initial endoscopic aspect and the treatment outcome. The same study noted that the best results were achieved in patients with incontinence after radical prostatectomy (Westney et al., 2005) (Fig. 10.9).

Regarding autologous fat injection, short-term results were very good, but the volume of the injected mass decreased by up to 65% in the first 6 months due to a reabsorption phenomenon, leading to a recurrence of symptoms in most cases (Palma et al., 2005). Regarding the injection of Teflon, results vary widely depending on the authors cited: Lopez et al. (1993) reported a 50.3% success rate at 31 months, Harrison et al. (1993) reported a 33% cure rate at 5 years, while Beckingham et al. (1992) reported a 27% success rate at 3 years. The low success rate and frequent severe complications have decreased the interest in this technique. A periurethral approach with the injection of a much smaller quantity of Teflon has also been reported (Herschorn and Glazer, 2000).

The clinical data available concerning the use of Durasphere has shown lower success rates compared with other bulking agents, as well as reports that periurethral abscesses or granulomas developed shortly after surgery. Some authors have expressed concern that this substance may also spontaneously migrate into the blood flow, due to the high injection pressures required by this technique (Pannek et al., 2001). These theories are not supported by clinical data (Ritts, 2002).

Regarding Tegress, no clinical data is currently available to support grade A or B recommendations. However, the available evidence suggests a similar efficacy to other injectable agents (Dmochowski, 2005). There are also no strong clinical data regarding the results of using Zuidex in urinary incontinence, but the FDA approval process is on-going

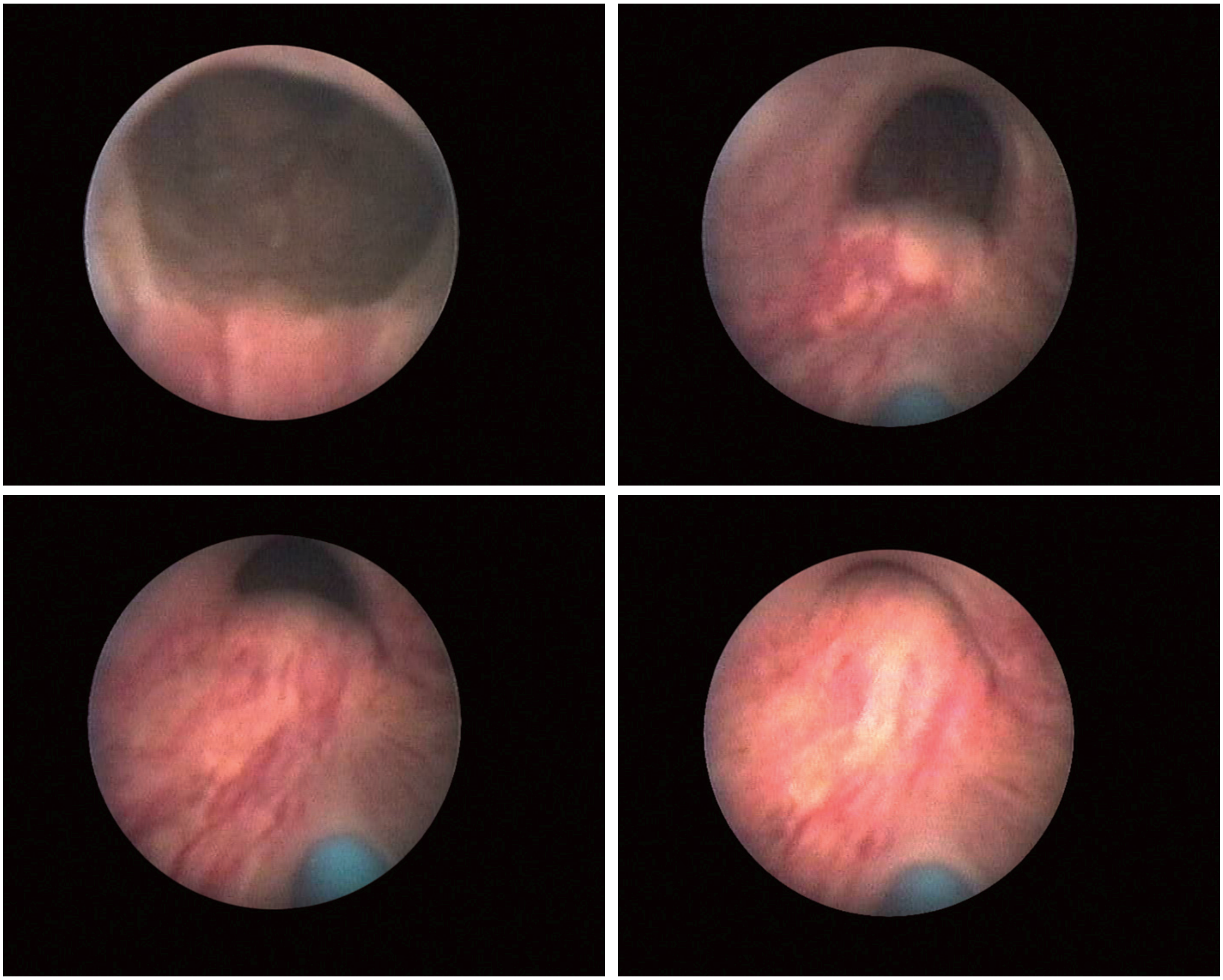

FIGURE 10.8 **Transurethral bovine collagen injection performed for sphincter incompetence after TURP.**

(Van Kerrebroeck et al., 2004). In Europe, Zuidex is approved for the treatment of stress urinary incontinence; in a group of 20 patients, Stenberg et al. (2003) reported favorable results in 57% cases and the absence of any improvement in 15% of patients.

There is a single clinical study for calcium hydroxyapatite, conducted on a small group of patients with a follow-up period of 1 year, with a success rate (cure and improvement) of 90% and the absence of side effects (Mayer et al., 2001). The substance was approved by the FDA in 2005.

Cell injection therapy is a promising alternative. However, the results available regarding the use of auricular chondrocytes as bulking agents are modest, while the safety profile is comparable to other bulking agents. In a study conducted on a small group of patients, Strasser et al. (2004) achieved a cure rate of 100% of cases in female patients and in 30% of cases in male patients, but the study did not provide follow-up information. Another theory explained that the disappointing results of the treatment were due to alteration of the myogenic potential of the cells during the enzyme digestion stage that precedes the culture phase. It is thus believed that the expansion of the cell cultures is a "sterile" process because the number of viable muscle cells does not increase, although the total number of cells can increase several times (Montarras et al., 2005).

A paper published in 2007 is the strongest argument in favor of cellular therapy. A number of 119 patients were injected with myoblasts and fibroblasts harvested from the brachial biceps muscle; 1 year after the procedure, 79% of patients were completely continent, 13% showed a significant improvement, while aggravation of the symptoms

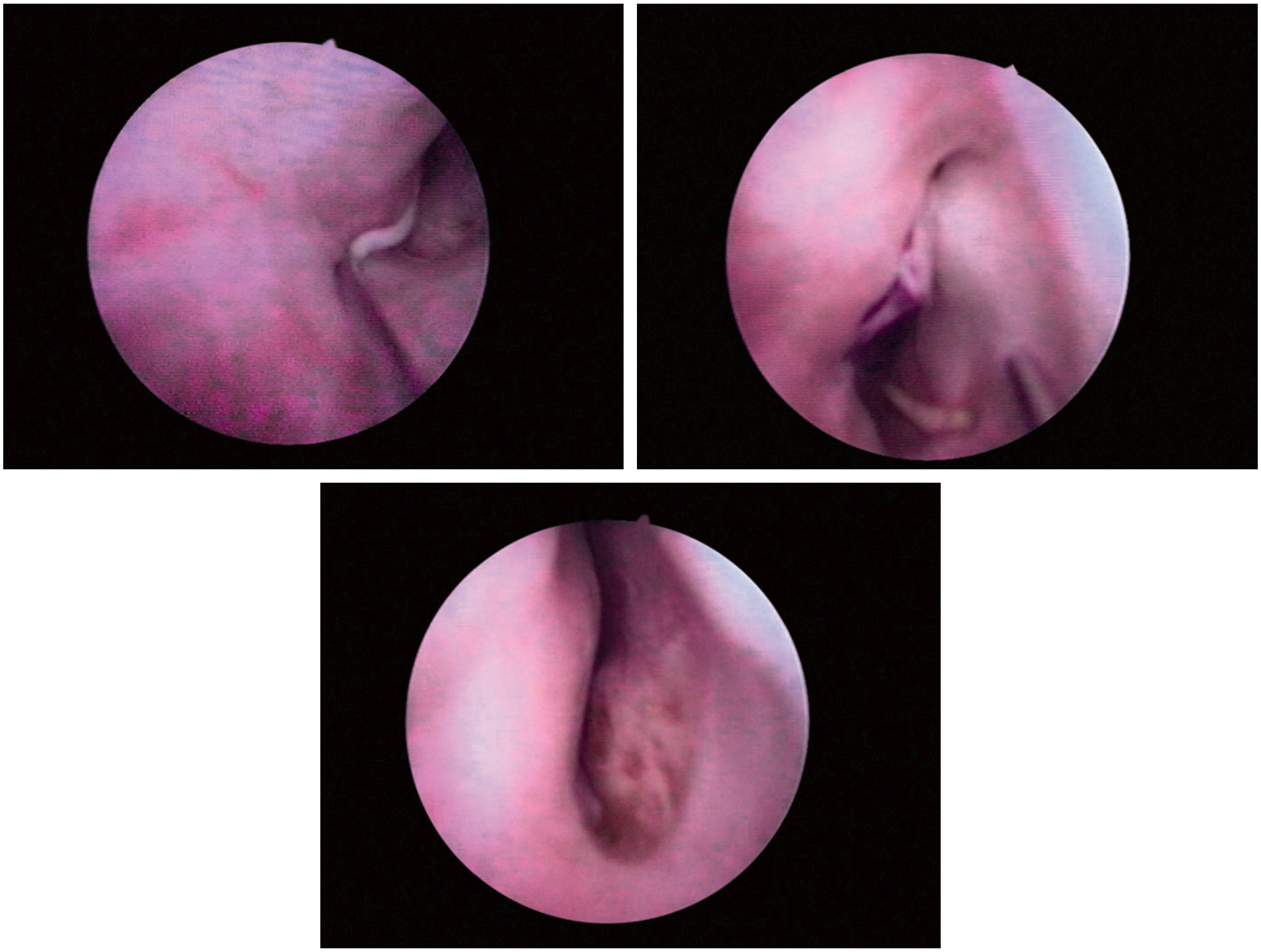

FIGURE 10.9 **Collagen injection in a patient with urinary incontinence after radical prostatectomy.**

was not reported in any of the patients. The major advantage of autologous cells as bulking agents is their superior biocompatibility compared with that of synthetic materials.

Some authors believe that the disappointing results of cellular therapy are caused by the injection technique under cystoscopic control, which does not allow the viewing of the entire striated sphincter, leaving room for discussion on the accuracy of this technique. An alternative technique is proposed, in which the injection is performed under ultrasound control, in order to visualize the area in which the cell population is introduced.

10.8 THE ADJUSTABLE CONTINENCE THERAPY (ACT) SYSTEM

Although the ACT system was first used in 2000, it continues to be an important representative of the new wave of devices recommended in the treatment of stress urinary incontinence, for both male and female patients. The device is composed of two silicone balloons, whose volume can be modified by the percutaneous puncturing of a port connected to the balloons, depending on the particular requirements of each case.

The principle of this technique is to lift and compress the membranous urethra and the bladder neck using the silicone balloons. The main advantage of the ACT system, compared with most of the available bulking agents, is the continuous possibility of modifying the pressure and, implicitly, the volumes of these balloons until urinary continence is obtained, or even to remove them if satisfactory results are not obtained. If the patient develops complete retention of urine immediately after device implantation, the volume of the balloons can be temporarily lowered. It should be noted that if the device proves to be ineffective, it can be easily removed, allowing the implementation of any other therapeutic alternative.

The device is implanted posterior to the bladder neck, symmetrically. The balloons are filled with an isotonic contrast agent that allows for facile monitoring and implantation. Saline is used in patients allergic to the contrast substance. The technique is relatively simple and requires a small perineal incision, after which the balloons are mounted under fluoroscopic and endoscopic control. The procedure can be performed with a 1-day hospitalization, under antibiotic treatment.

Compared with the artificial urinary sphincter, this surgical technique is much less laborious, and the results currently available show comparable success rates. Because the ACT system does not exercise circumferential compression on the bladder neck, as is the case with the artificial sphincter, the risk of urethral atrophy due to decreased tissue perfusion secondary to extrinsic compression is greatly reduced (Chartier-Kastler et al., 2007).

The contraindications of the ACT system are active urinary infections, detrusor overactivity, decreased bladder compliance, post voiding residual volume of over 100 mL, and bladder tumors. The general contraindications for urinary incontinence surgery must also be added, including pregnancy, bladder stones, and coagulation disorders or other systemic diseases that may endanger the patient's life.

A relative contraindication for implantation of this device is pelvic radiotherapy, which is commonly associated with device migration or erosion of the bladder neck.

Although not a contraindication, prostatic stents or titanium clips can create difficulties in the positioning of the ACT device.

Potential complications of this treatment include the risk of device malfunction or spontaneous migration, tissue damage caused during the implantation procedure or erosion of the tissues that come into contact with the balloons. Data in the literature show that a percentage of patients does not respond to this technique, without any identifiable causes. Major complications of the ACT system are represented by severe infections and *de novo* detrusor overactivity, but the incidence of these complications is not yet known (Lebret et al., 2006).

If urethral slings are representative for the minimally invasive treatment of choice in female patients with stress urinary incontinence, modern therapeutic options for male patients are still scarce, so that the ACT device (ProACT) has a chance to establish itself swiftly. Currently available results indicate a success rate of 75% (cured and improved) in male patients (Hübner and Schlarp, 2005; Schlarp and Huebner, 2006). In female patients, the data obtained after the implantation of over 1000 ACT devices show that in 62% of cases loss of urine disappeared completely, and in 16% of cases the symptoms improved significantly (Kocjancic et al., 2006).

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CHAPTER

11

Endoscopic Management of Urethral Abnormalities

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11.1 CLASSIFICATION OF URETHRAL ABNORMALITIES

A series of congenital urethral malformations have been reported:

- Lacuna magna or Guérin’s sinus – this is a diverticulum located in the posterior wall of the navicular fossa. It appears as a 4–6 mm deep depression in the terminal urethra, emerged from an incomplete ectodermal fusion between the glans and the glandular urethra.
- Urethral duplicity – this is a rare anomaly characterized as epispadias, hypospadias, or “Y” type terminal urethra. These malformations may be complete or incomplete, and in the latter case the connection with the urinary tract can have a varied aspect. In cases with complete duplicity, patients may urinate with a double stream. The most common type of urethral duplication is the “Y” type; with an orthotopic meatus and a perineal meatus, which takes up most of the urine. The etiology of these conditions is not known.
- Urethral valves – these are folds of the urethral mucosa that create an obstruction in the discharge of urine. They can be located in the anterior or the posterior urethral wall.
- Megalourethra – this implies a greatly increased caliber of the entire anterior segment. This abnormality can be characterized as a diverticulum affecting the whole penile urethra. Two types of megalourethra have been described, scaphoid and fusiform. The scaphoid type is characterized by an absence of the corpus spongiosum, while the fusiform type is characterized by an absence of both the corpus spongiosum and the corpus cavernosum. Fusiform megalourethra is often associated with lethal congenital anomalies and, therefore, this diagnosis is important especially from a scientific point of view.
- Urethral diverticula – these are structures shaped like glove fingers, projected outside the normal urethral duct and communicating with it through an orifice (Fig. 11.1).
- Urethral polyps – these are rare malformations, characterized as benign urethral tumors anchored by a fibrovascular pedicle to verumontanum that appear almost exclusively in male patients.
- Cowper’s duct cysts – these occur in two periurethral structures (the Cowper glands) located in the urogenital diaphragm. These are drained by 2–3 cm long ducts that open in the bulbar urethra through two small orifices. The Cowper glands, which are the counterparts of the Bartholin gland found in the female urethra, secrete a clear fluid that acts as a lubricant and coagulation factor for sperm during ejaculation. Abnormalities of these glands and their ducts can lead to retention and, less commonly, infection and gland injury.
- Urethral prolapse – this is a complete protrusion of the mucosa through the female urethral meatus. This is an uncommon condition, occurring especially in prepubescent black and Latin-American girls. Increased incidence has been reported in children with lower socioeconomic levels. This condition seems to be the result of an increased laxity between the longitudinal and the circular urethral muscle layers and the urethral mucosa in association with recurrent episodes of increased intra-abdominal pressure. Other conditions such as trauma, malnutrition, and recurrent urethro-vaginal infections have been incriminated in the etiology of this disease.

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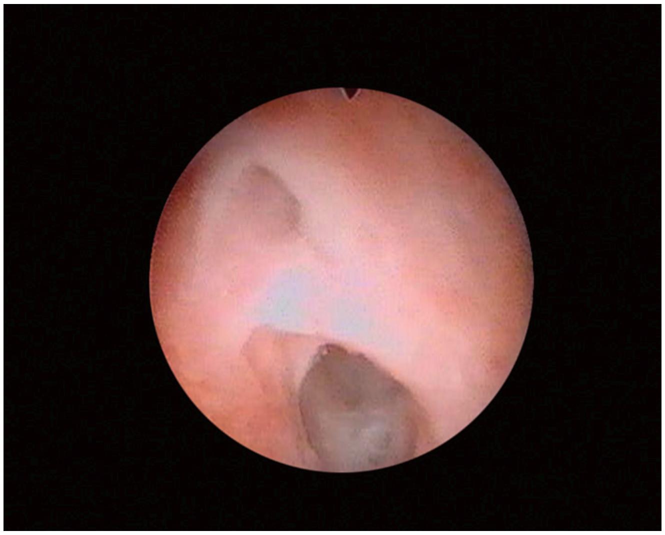

FIGURE 11.1 **Endoscopic aspect of multiple urethral diverticula.**

Among the previously mentioned malformations, the urethral valves, urethral diverticula, Cowper's duct cysts, and the fibroepithelial polyps may benefit from endoscopic treatment (the latter are described in the benign tumors section).

11.2 URETHRAL VALVES

11.2.1 Generalities

Urethral valves can be anterior or posterior. The second type is the most common obstructive congenital malformation of the urethra, as described by Hugh Hampton Young (Young et al., 1919). This condition presents with abnormal posterior urethral folds or membranes that prevent urine evacuation from the bladder. Presentation varies, from disease incompatible with life outside the womb to disease with minimum implications, sometimes diagnosed in adolescence.

Although several cases of congenital urethral obstruction have been reported in girls, posterior urethral valves are found almost exclusively in males (Smith et al., 1996). The incidence of these malformations is 1/8000–1/25,000 in male infants (Atwell, 1983; Thomas and Gordon, 1989).

Histological studies suggest that posterior urethral valves are formed concomitantly with the urethra, the ejaculatory ducts (Wolffian) merging with the cloacal membrane. The most commonly used classification of posterior urethral valves belongs to Young. He proposed three types (Young et al., 1919):

- Type I – the most common (95% of cases), characterized by an abnormal anterior fusion, distal to verumontanum, of urethral folds with persistence of a posterior canal.
- Type II – not obstructive, considered a simple hypertrophy of the folds lateral to seminal colliculus.
- Type III – presents as a diaphragm with a small central opening, probably due to an incomplete tubularization between the anterior and posterior urethra.

Urethral valves can cause severe subvesical obstruction with variable repercussions on the entire urinary tract. Increased intravesical pressure leads to the hypertrophy and hyperplasia of the bladder detrusor. An increased intravesical pressure gradient, on the long term, leads to functional insufficiency of the bladder and vesicoureteral reflux, with secondary ureterohydronephrosis and progression to renal function impairment.

Renal failure due to this malformation accounts for 10–15% of cases of children that are candidates for renal transplant in the United States. Also, about one third of affected children develop end-stage renal failure. Perinatal mortality among affected children reached 50%, due to pulmonary hypoplasia and sepsis. Due to improved perinatal care measures and prenatal diagnosis of the disease, followed by premature pregnancy interruption, the mortality rate has dropped significantly in recent years, to less than 10%.

Anterior urethral valves are a rare condition, with a frequency seven to eight times lower than that of posterior valves, but with equally severe consequences. These lesions can occur anywhere in the anterior urethra, and the valve mechanism is commonly the result of an associated diverticulum, although there have been case reports in the literature of valves consisting of cusps or diaphragms (Goldman et al., 2000).

The embryological origin of anterior urethral valves differs from that of the posterior valves, and they occur distal to the urinary sphincter. About 40% are located in the bulbar urethra, 30% in the penoscrotal junction, and 30% in the penile urethra (Bartone, 1994). Over half of the cases associate upper urinary tract damage with vesicoureteral reflux or hydronephrosis. Although much less common than posterior urethral valves, anterior ones can be just as obstructive, leading in some cases (<5%) to renal failure (Casale, 1999). Retrograde urethrography may miss the presence of valves as they remain open due to the retrograde flow, while routine urethroscopy can misdiagnose them if the investigator does not specifically aim to highlight the urethral valves (Schoellnast et al., 2004).

11.2.2 Indications

Because of routine obstetrical ultrasound, the prenatal diagnosis of posterior urethral valves has become increasingly facile. In this regard, the therapeutic efforts are being directed toward improving bladder drainage *in utero*. The postnatal diagnosis and treatment algorithm of urethral valves is well established, their management being increasingly less invasive due to the development of pediatric endoscopy instruments in recent decades (Dewan and Goh, 1995). The ultimate goal of all therapeutic interventions is the preservation of a normal function of the urinary tract, with protection of the renal units. Surgical treatment varies depending on age, on the condition of the bladder, and on the degree of kidney injury.

Due to modern pediatric endoscopic equipment, the urinary drainage is ensured in almost all patients through primary endoscopic ablation of urethral valves. It is hoped that, thanks to diagnostic and technological advances, prenatal surgery (valve ablation, vesico-amniotic shunt) will lead to the preservation of renal function until birth. However, identifying those patients who could benefit from this form of early surgical intervention is difficult. To date, improvements in renal function are far from being demonstrated and prenatal interventions are still experimental (Soliman, 2009).

The surgical treatment of anterior valves is a matter of controversy. Thus, Rushton et al. (1987) recommended placing a cystostomy catheter in newborns as a first step followed by the endoscopic ablation of valves as a second stage of treatment. Other authors recommend two-stage urethroplasty, performing the first stage in the neonatal period. Savage et al. have proposed a treatment algorithm that takes into account the moment of diagnosis, the severity of the obstruction and the relationship between the size of the diverticulum and the size of the penis.

In newborns, bladder decompression is performed with a Foley catheter and serum creatinine is monitored. In patients with important bilateral vesicoureteral reflux, placing a cystostomy catheter is recommended in order to achieve a low pressure urinary tract drainage.

In older children valves can be fulgurated, without mounting a urinary catheter, in cases in which the urethra has an adequate caliber and sufficient periurethral tissue.

By following these criteria, it is considered that almost half of the patients may be treated through a transurethral endoscopic approach (Nguyen and Peters, 1999). In patients with a large urethral diverticulum and a small urethral diameter, open urethroplasty is recommended. The type of urethroplasty depends on the size of the diverticulum related to the size of the penis.

11.2.3 Techniques

We will present the endoscopic treatment for posterior urethral valves. For the treatment of anterior urethral valves, the surgical technique and type of energy are identical (Nguyen and Peters, 1999).

11.2.3.1 Anesthesia

Ideal treatment involves endoscopic ablation of the urethral valves in the first days of life outside the womb. Therefore anesthesia needs to be adapted to the patient's age. Thus, if the treatment is performed in adolescence, the procedure can be performed under local or regional anesthesia. In children, general anesthesia is preferred.

11.2.3.2 Patient Positioning

The anesthetized patient is placed on the operating table in the classical lithotomy position and sterile drapes are placed.

11.2.3.3 Endoscope Insertion

The procedure begins with the recalibration of the urethral meatus, gently dilated to 9F. The endoscope is inserted into the urethra under direct visual control (watching carefully for endoscopic anatomy landmarks) and ascended to the lesion (Bani Hani et al., 2006).

11.2.3.4 Urethral Valve Ablation

Thanks to progress in the last decades, pediatric endourology instruments allow the use of cystoscopes and resectoscopes with smaller diameters (up to 4.5 and 8F, respectively), leading to easier urethral manipulation in newborns. Transurethral valve ablation under visual control represents the standard initial treatment in the management of posterior urethral valves.

Data from the literature concludes that placing a 5–8F cystostomy tube in order to treat a urinary tract obstruction offers no long-term improvement of renal function compared to primary valve ablation (Farhat et al., 2000; Podesta et al., 2002).

Typically the incision/destruction of the valves is performed at the 12, 5, and 7 o'clock positions. Various types of energy can be used: cold knife (Fig. 11.2), usually in the form of a hook (hook cold knife), electroresection (Fig. 11.3), or laser.

During the perinatal period, this procedure encounters some difficulties in accommodating the instruments to the urethral caliber and depth of thermal injuries relative to the thickness of the urethra or spongiosa.

Another technique used especially for children with low birth weight (<2000 g) is the urethral valve ablation with a 2F Fogarty catheter, this procedure presenting the disadvantage of being a "blind" maneuver and the radiological exposure of the newborn baby (Diamond and Ransley, 1987; Kyi et al., 2001; Chertin et al., 2002; Soliman, 2009).

11.2.3.5 Placing a Urinary Catheter

Some authors prefer placing and maintaining a urinary catheter for pediatric use (5–8F) for 2–3 days.

11.2.3.6 Treatment Efficacy Control

Treatment efficacy is verified by urethroscopy. The endoscopic comparison of the anterior and the posterior urethral diameters, after valve ablation, is an objective criterion for determining if the procedure was successful. Preoperatively, the posterior urethra is dilated in most patients and this difference should decrease postoperatively. Because about one-third of patients require secondary valve incision, some authors recommend routine cystoscopy at 1–2 months after initial treatment in order to assess and treat any residual valves (Horowitz et al., 2009).

11.2.4 Complications

Complications of endoscopic ablation of posterior urethral valves are relatively common to other endoscopic procedures in the lower urinary tract. They can be represented by incomplete destruction of the valves, minimal local bleeding, urethral perforation, etc.

11.2.5 Results

The high rate of repeated valve ablation (25–30%), reported by some authors, certifies the difficulty of these endoscopic maneuvers relative to the size and fragility of the urethra (Duckett and Snow, 1986; Bani Hani et al., 2006). There have been reports of posterior valve ablation success rates ranging from 82% to 100%, using Nd:YAG laser with small fibers (Ehrlich et al., 1987; Biewald and Schier, 1992; Bhatnagar et al., 2000).

11.3 URETHRAL DIVERTICULUM

11.3.1 Generalities

Lower urinary tract diverticula can develop in the bladder or urethra in both men and women.

The incidence of urethral diverticula is approximately 1–5% (Dmochowski, 2002), with a peak incidence between the third and fifth decades of life, without predilection for a specific race (Leach and Bavendam, 1987), although earlier studies suggested an increased incidence in black women. If bladder diverticula occur more frequently in men, the urethral diverticula are diagnosed more often in adult women.

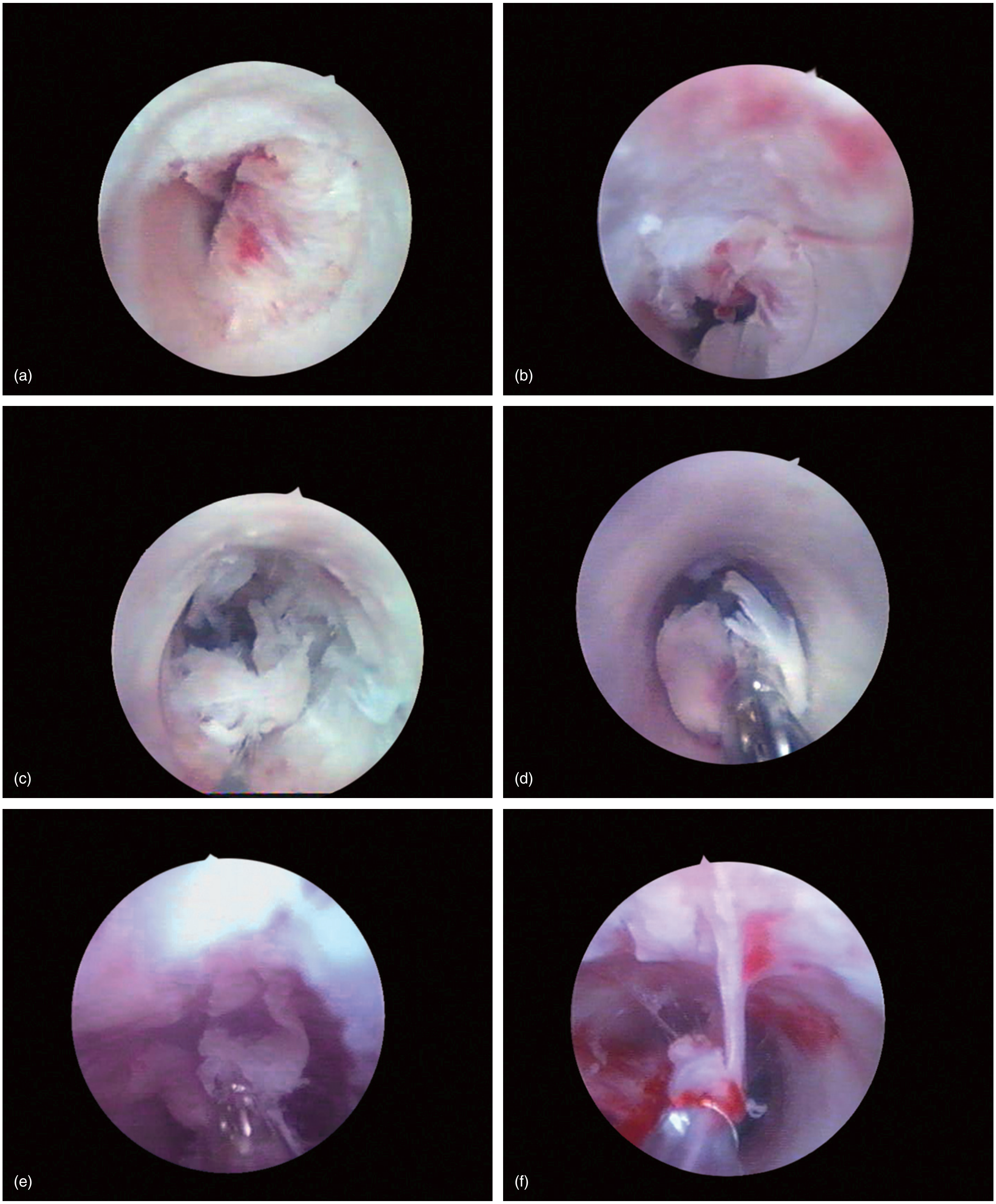

FIGURE 11.2 **Anterior urethral valves (a), for which cold blade incision is performed (b, c), followed by extraction using a forceps (d–f),**

(Continued)

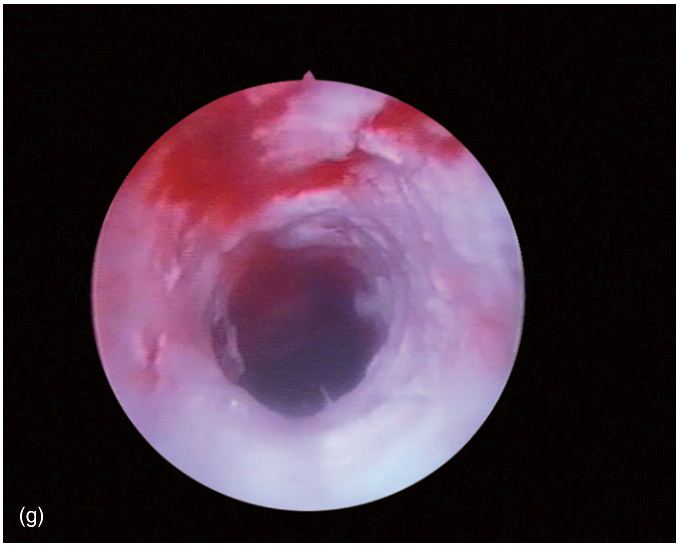

FIGURE 11.2 *(Cont.)* **obtaining a wide lumen (g).**

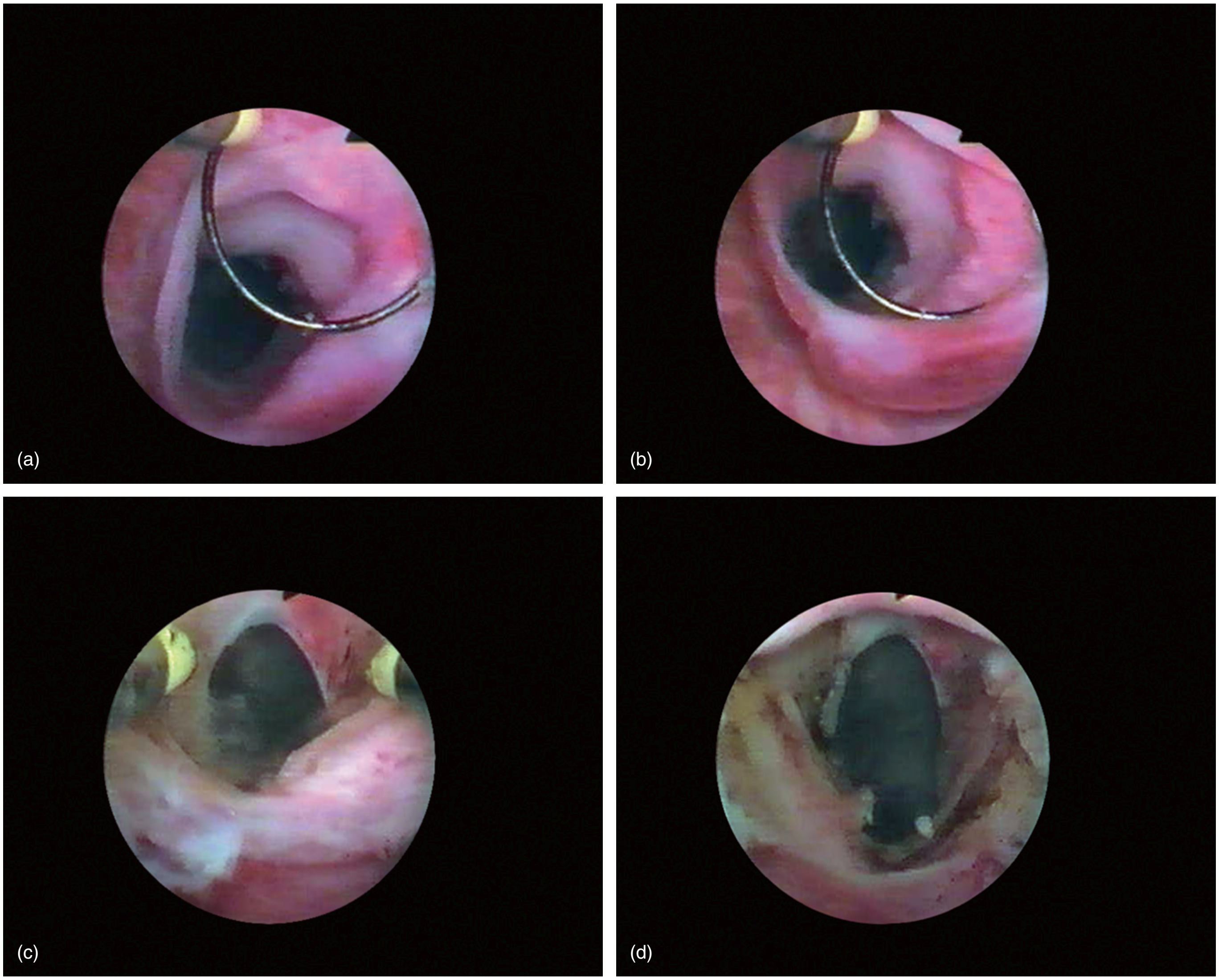

FIGURE 11.3 **Posterior urethral valves (a) for which electroresection is performed (b, c), obtaining a wide urethral lumen (d).**

Most diverticula are acquired. Paraurethral glands inflammation is involved in their pathogenesis, leading to cystic dilation and obstruction of the gland's communication channel with the urethra. The cystic mass increases in size and eventually perforates into the urethral lumen, followed by epithelialization of the resulted cavity, forming the urethral diverticulum (Ganabathi et al., 1994). The etiologic agents involved include gonococcus, as well as normal vaginal flora. The urethral diverticulum occurs more frequently in the distal portion of the urethra, in the area where Skene's glands are located, the largest of the periurethral glands.

11.3.2 Indications

Surgery is the treatment of choice for urethral diverticula. Although long-term antibiotic therapy with low doses relieves symptoms, it does not provide a sustainable solution for the anatomic defect (Larkin and Weber, 1996).

In the case of an incidental discovery of an asymptomatic urethral diverticulum, surgical excision is not mandatory, but patients should be closely monitored due to the risk of complications such as diverticular stones or malignant transformation. Surgical intervention is indicated in patients with troublesome symptoms, nonresponsive to conservative treatment or in those who experience complications.

Several open and endoscopic surgical techniques have been proposed for the treatment of urethral diverticula. Surgical excision of the diverticulum is the "gold standard" in the treatment of this condition. All the other techniques described in the literature have, at least theoretically, the disadvantage of not removing the diverticular sac and of not reconstructing the periurethral tissue, leading to an increased rate of recurrences and complications.

Diverticular sac marsupialization in the vagina (Davis and Robinson, 1970) is indicated for distal diverticula and consists in incising the urethral and vaginal wall through the diverticulum, up to the diverticular orifice. The cavity inspection and biopsy sampling follows, after which the diverticular orifice is closed and the urethral wall and vagina are sutured.

Endoscopic treatment is represented by saucerization, especially useful for women with recurrent multiple diverticula and with previous surgical interventions.

Other techniques that are seldom used are represented by the incision of the diverticular cavity, followed by filling with oxy cellulose (Oxicel) or Gelfoam (abandoned due to complications), transvaginal partial ablation, and the use of the diverticular sac as a second layer after closing the orifice, or periurethral injection of Polytef paste adjacent to the diverticulum in order to cause collapse thereof (a technique with a significant risk of infection and abscess) (Mizrahi and Bitterman, 1988).

11.3.3 Techniques

11.3.3.1 Anesthesia

The simple endoscopic highlighting of a diverticulum through urethroscopy can be performed under local anesthesia. If the aim is to treat the lesion during the same procedure, regional anesthesia is preferred.

11.3.3.2 Patient Positioning

The patient is placed in the classic lithotomy position, properly covered with sterile drapes.

11.3.3.3 Highlighting the Diverticulum

The urethra is inspected endoscopically, paying particular attention to the floor and the sidewalls. In women, due to the short length of the urethra, diverticular orifices are likely to be observed when withdrawing the cystoscope from the bladder neck toward the external urethral meatus because during this maneuver a better distension of the conduct is achieved compared with retrograde inspection (Fig. 11.4).

If the diverticular orifice is wide, the cavity can be inspected with the endoscope (Fig. 11.5).

At this stage the careful inspection and palpation of the vaginal wall is performed, highlighting a mass (Fig. 11.6) or a thickened and possibly painful area that may indicate the presence of a diverticulum. Compressing this mass can lead to evacuation of purulent secretions or urine into the urethra, this being a pathognomonic sign for this condition. The sign may be absent if the communication orifice of the urethral diverticulum is stenosed (Robertson, 1996).

11.3.3.4 Destruction of the Diverticulum

In the case of transurethral saucerization of the diverticulum, its cavity can be opened into the urethral lumen using different energy sources: electricity (with a Collins loop or different electrodes), or lasers (Nd:YAG, Ho:YAG). The incision can also be performed with a cold blade (e.g., Pott scissors) (Ellik, 1957; Lapides, 1979).

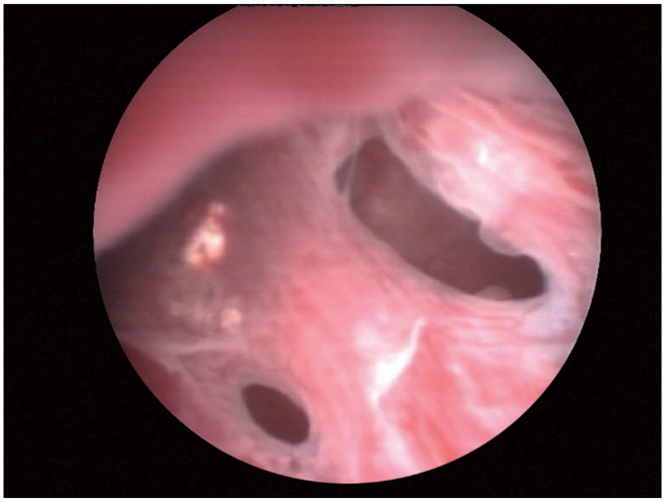

FIGURE 11.4 Multiple urethral diverticular orifices.

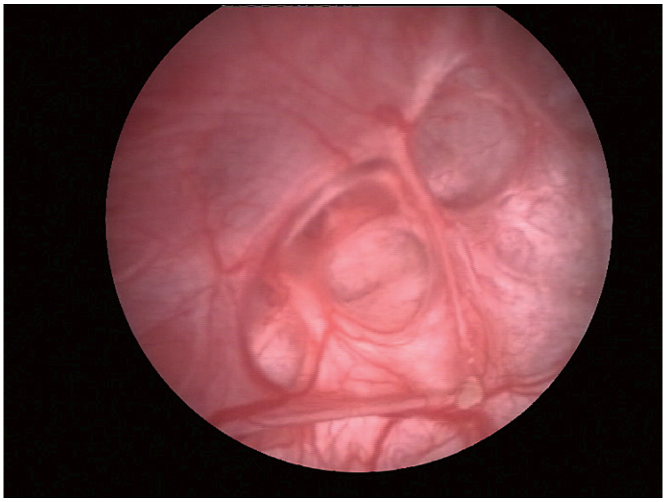

FIGURE 11.5 Aspect of a diverticulum cavity accessed with an endoscope.

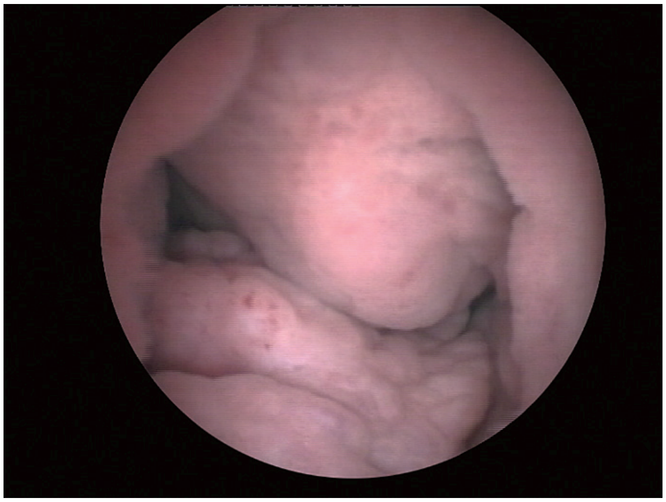

FIGURE 11.6 Endovaginal aspect of a urethral diverticulum.

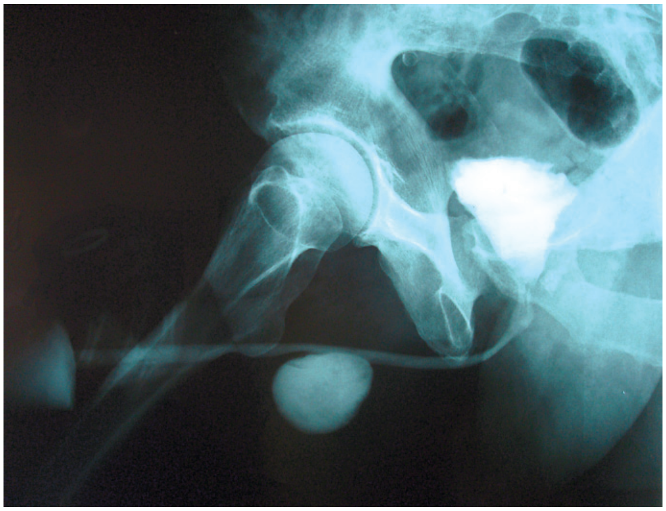

FIGURE 11.7 Giant urethral diverticulum with diverticular stones.

11.3.3.5 Diverticular Sac Inspection

The diverticular sac is inspected due to the risk of malignant tumors that may occur at this level (adenocarcinoma, squamous/transitional cell carcinoma) (Shalev et al., 2002; von Pechmann et al., 2003) or to the presence of nephrogenic adenoma (Klutke et al., 1995). If necessary, it will be biopsied or surgically excised for anatomopathological examination.

In 1.5–10% of cases diverticular stones may occur as a result of stasis, and in this surgical stage the stone can be extracted "en bloc" or after lithotripsy (Figs 11.7 and 11.8) (Martinez-Maestre et al., 2000).

11.3.4 Complications

The endoscopic treatment of urethral diverticula may be associated with a number of complications such as relapse (1–29%), urethro-vaginal fistula (0.9–8.3%), stress urinary incontinence (1.7–16 %), or urethral strictures (1–2%) (Dmochowski, 2002).

11.3.5 Results

The results of endoscopic saucerization are promising; however they are subject to very limited indications. Thus, in a study of six female patients with recurrent urethral diverticula after open surgical treatment, an endoscopic approach with electrical incision led to the disappearance of the symptoms and the absence of infection in all cases, over a follow-up period between 18 months and 84 months (Saito, 2000).

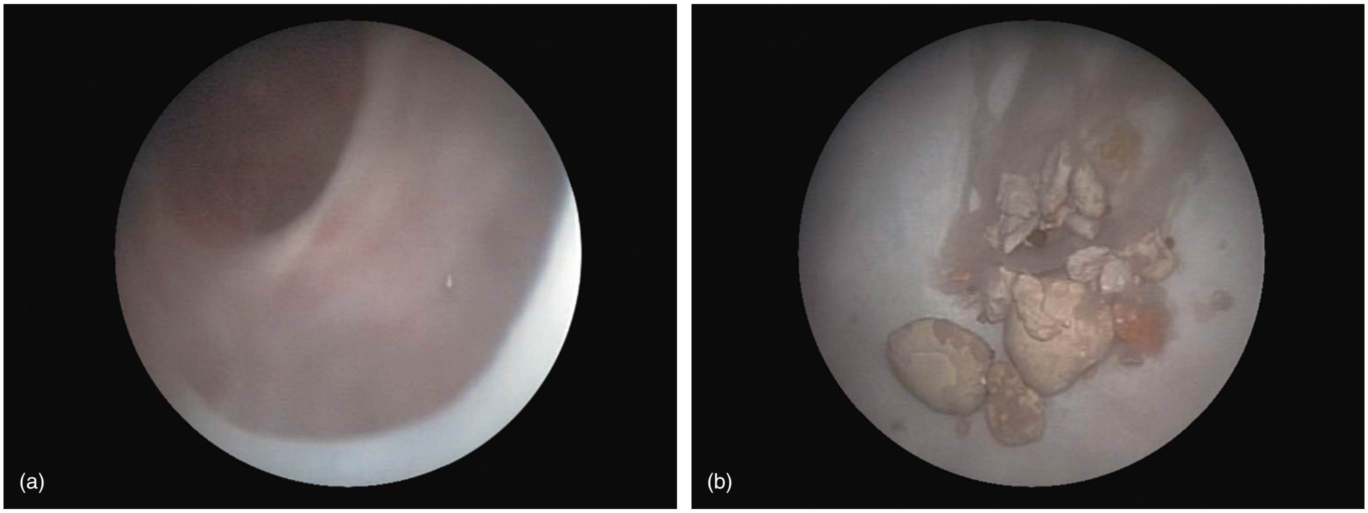

FIGURE 11.8 **(a) The diverticulum orifice and (b) diverticular stones.**

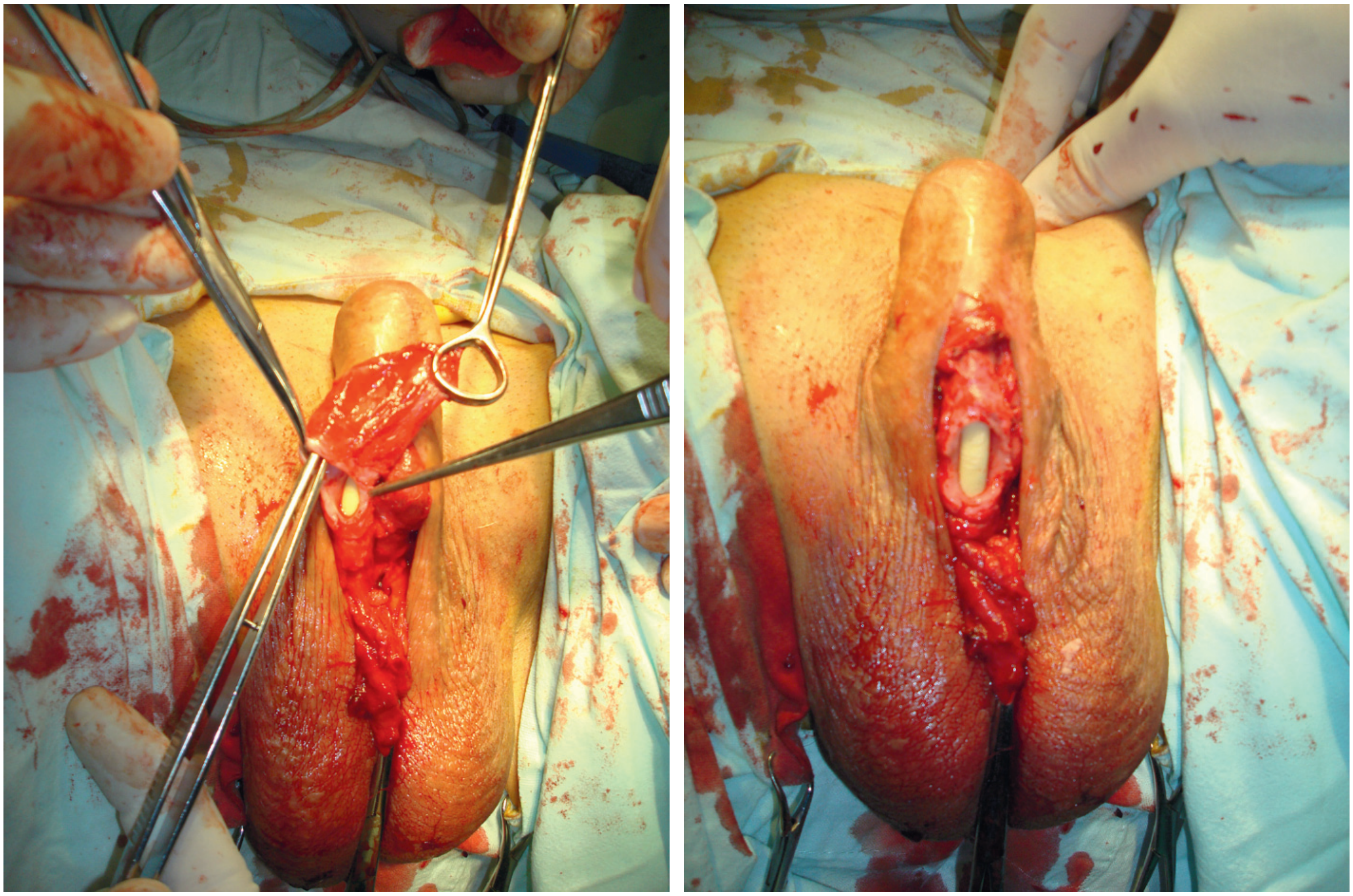

FIGURE 11.9 **Open surgical resection of the urethral diverticulum.**

In order to obtain the best results, this type of approach is recommended especially for distal urethral diverticula, the incision of the diverticulum orifice providing a broad opening into the urethra, thus facilitating an easy drainage. However, if this technique is used for medial or proximal diverticula, the risk of urinary incontinence is higher. Also, performing this technique for bulky diverticula leads to modest results because the cavity resulting after incision will have a poor drainage. Furthermore, this procedure cannot treat any associated stress urinary incontinence. For this reason, open surgery is recommended for this type of diverticula (Fig. 11.9).

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CHAPTER

12

Verumontanum

Petrişor Geavlete, Răzvan Mulţescu, Victor Mirciulescu, Bogdan Geavlete

12.1 GENERALITIES

The verumontanum (Fig. 12.1) is a structure located on the floor of the posterior urethra, which marks the boundary between the membranous and the prostatic segment. During endoscopic resections, it represents a landmark of the striated sphincter and, implicitly, of the lower limit of the intervention. Usually it has a length of 15–17 mm and a height of 3 mm, although there are numerous variations of both shape and size. On both sides of the urethral ridge, the orifices of the prostatic ducts open, and the ejaculatory ducts' orifices and prostatic utricle orifice can be found on the upper edge (Dyson, 1999; Moore et al., 2005).

The structure of the verumontanum consists in striated muscle fibers of the external sphincter, interwoven with smooth muscle tissue from the urethral wall (Benoit et al., 1986). Marking a crossroads between the urinary and the genital tracts, verumontana may be affected in a number of pathological lesions. Also, the spermatic path can be explored for diagnostic purposes through the verumontanum. The endoscopic approach of this structure, for both diagnostic and therapeutic intent, may prove essential in the management of male infertility.

12.2 VERUMONTANUM CLASSIFICATION

One classification divides verumontana into physiological verumontana (not clinically significant), verumontana with urinary consequences, or verumontana significant for genital pathology (Geavlete et al., 2006).

Physiological verumontana may have various shapes and sizes, a morphological classification dividing them into:

- Flat verumontanum (Fig. 12.2)
- Elongated verumontanum (Fig. 12.3)
- "Humpback" verumontanum (Fig. 12.4)
- Very long verumontanum (Fig. 12.5)
- "Helmet" shaped verumontanum (Fig. 12.6)
- Verumontanum with the aspect of a diverticulum (Fig. 12.7)
- Other forms – represented by mixed or intermediate forms between the categories most frequently encountered (Fig. 12.8).

The verumontanum can be hypertrophied in some patients, and this oversized structure may have urinary consequences (Fig. 12.9).

An aspect of the spermatic ducts opening into verumontanum may suggest a genital pathology (Fig. 12.10).

12.3 VERUMONTANUM PATHOLOGY

A relatively wide range of pathological changes can occur in the verumontanum. The inflammatory modifications of this structure complement the broader picture of prostatitis and urethritis. In acute conditions, hyperemia and edema occur in the verumontanum, in some cases with a pseudotumoral aspect (Fig. 12.11).

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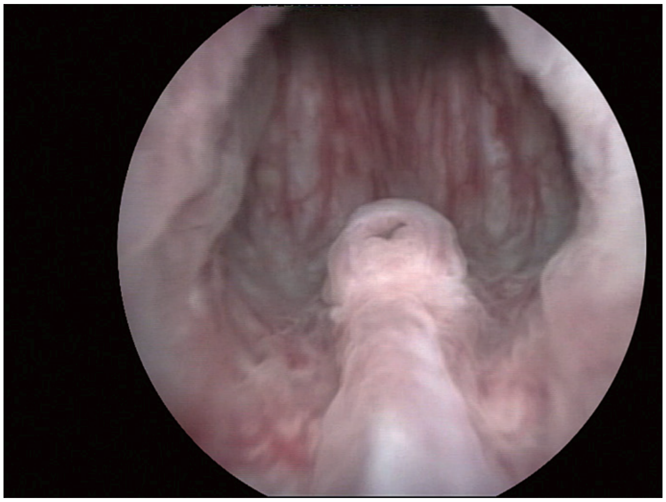

FIGURE 12.1 **Endoscopic aspect of verumontanum.**

In chronic prostatitis with a history of acute episodes, the mucosa appears pale with multiple punctiform brown inclusions (Fig. 12.12).

Fibroepithelial polyps (Fig. 12.13) of the posterior urethra may be located in the verumontanum (Mazeman et al., 1980; Geavlete et al., 2001). The clinical symptoms of this disease include dysuria, urethrorrhagia, initial hematuria, urinary infections, subvesical obstruction or, in rare cases, infertility (Castiñeiras Fernández et al., 1991).

Endoscopic treatment of these polyps was described previously in the section on benign tumors of the urethra (Fig. 12.14), with sparing of the verumontanum in general and especially of the sperm tracts orifices.

Another pathology of the verumontanum is represented by malignant tumors. They may be primitive or secondary. Primitive tumors may originate in the prostatic ducts (and they protrude into the urethra through prostatic duct orifices) (Fig. 12.15) or in the mucosa of the verumontanum (Fig. 12.16). Secondary tumors may occur by seeding on the verumontana of cells detached from bladder urothelial tumors (Fig. 12.17).

These tumors must be biopsied endoscopically, either with forceps or resection (Figs 12.18 and 12.19). In the case of small tumors, this procedure can be considered to be therapeutic.

The prostatic utricle cyst is a rare condition manifested by infertility, changes in sperm parameters (oligospermia, teratospermia, asthenospermia), hematospermia, etc. (Ruf et al., 1993; Geavlete and Niţă, 2000). This condition is treatable through endoscopy, usually by electroresection or incision of the verumontanum or of the floor of the prostatic urethra (Moukaddam et al., 2003; Meza-Vázquez et al., 2008) (Figs 12.20 and 12.21). There are authors who dispute the efficacy of this method, at least in terms of correcting infertility (Cornel et al., 1999).

Transurethral resection or incision of ejaculatory ducts in patients with infertility and obstruction at this level of the sperm ducts has been reported (Schroeder-Printzen et al., 2000; Paick, 2000). However, the results are superior in patients with congenital obstruction compared with those in whom the obstacle is acquired (Netto et al., 1998).

Very rarely, prostatic utricle stones may be reported. They can be endoscopically extracted with forceps (Fig. 12.22), eventually after incision of the orifice.

12.4 DIAGNOSTIC MANEUVERS THROUGH THE VERUMONTANUM

The verumontanum can be approached during endoscopic maneuvers such as retrograde deferentography. This procedure requires catheterization of the sperm ducts with Chevassu catheters inserted through the cystoscope, with injection of contrast medium at this level, followed by fluoroscopic exposure in order to assess the seminal vesicles and vas deferens (Fig. 12.23).

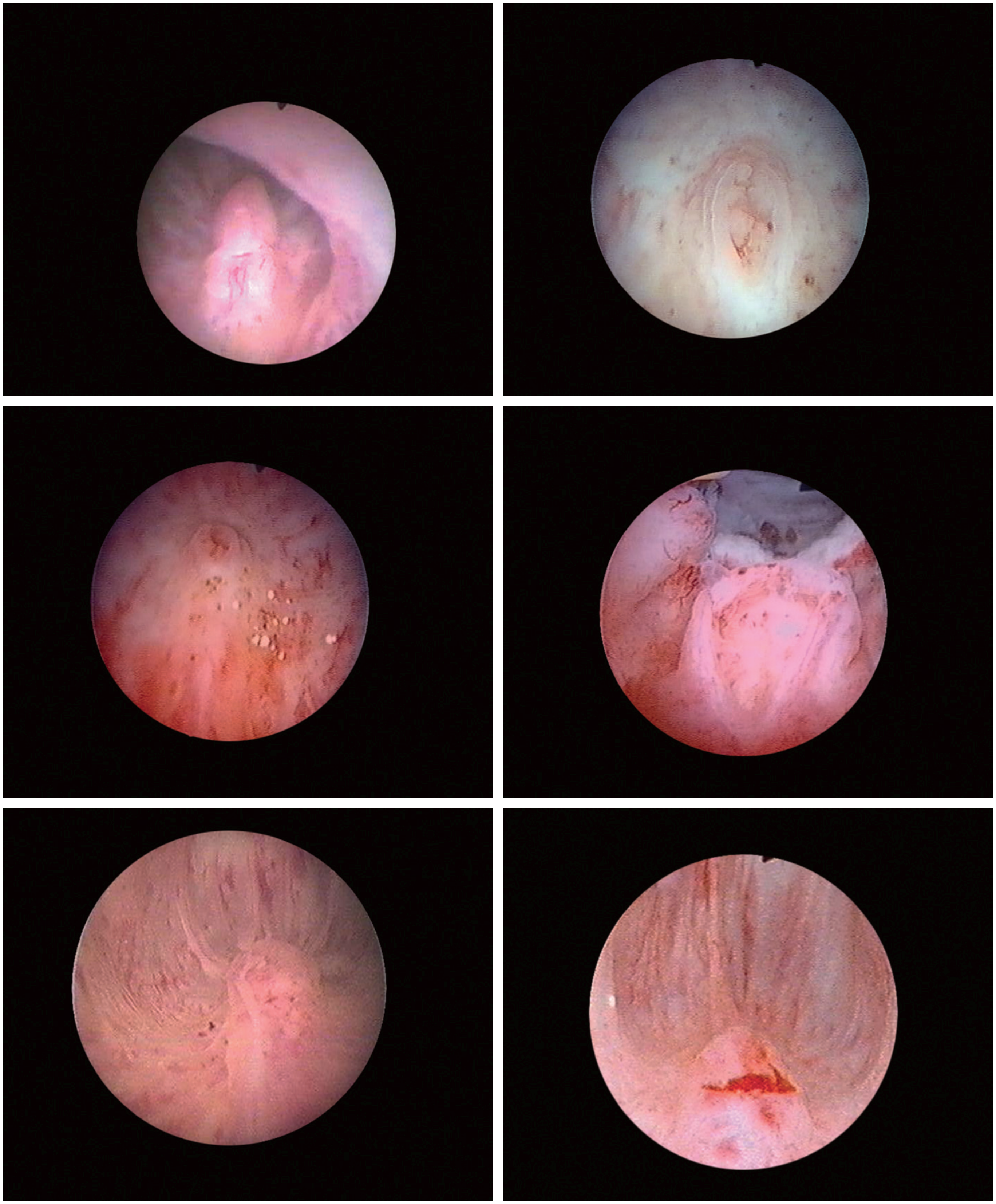

FIGURE 12.2 Aspects of flat verumontanum.

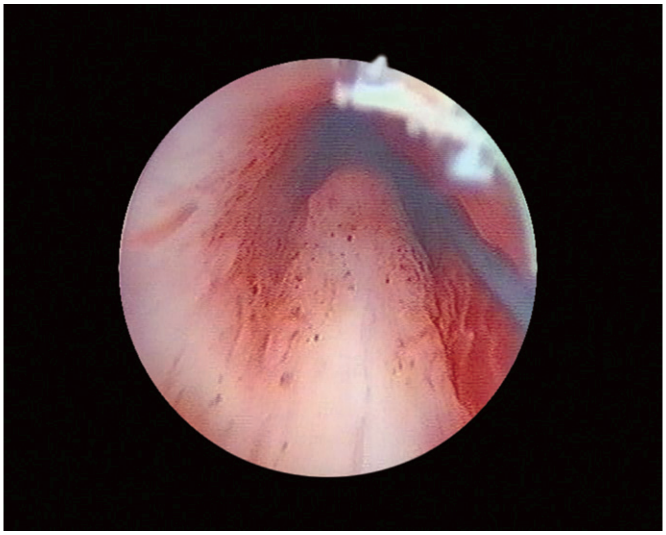

FIGURE 12.3 **Elongated verumontanum.**

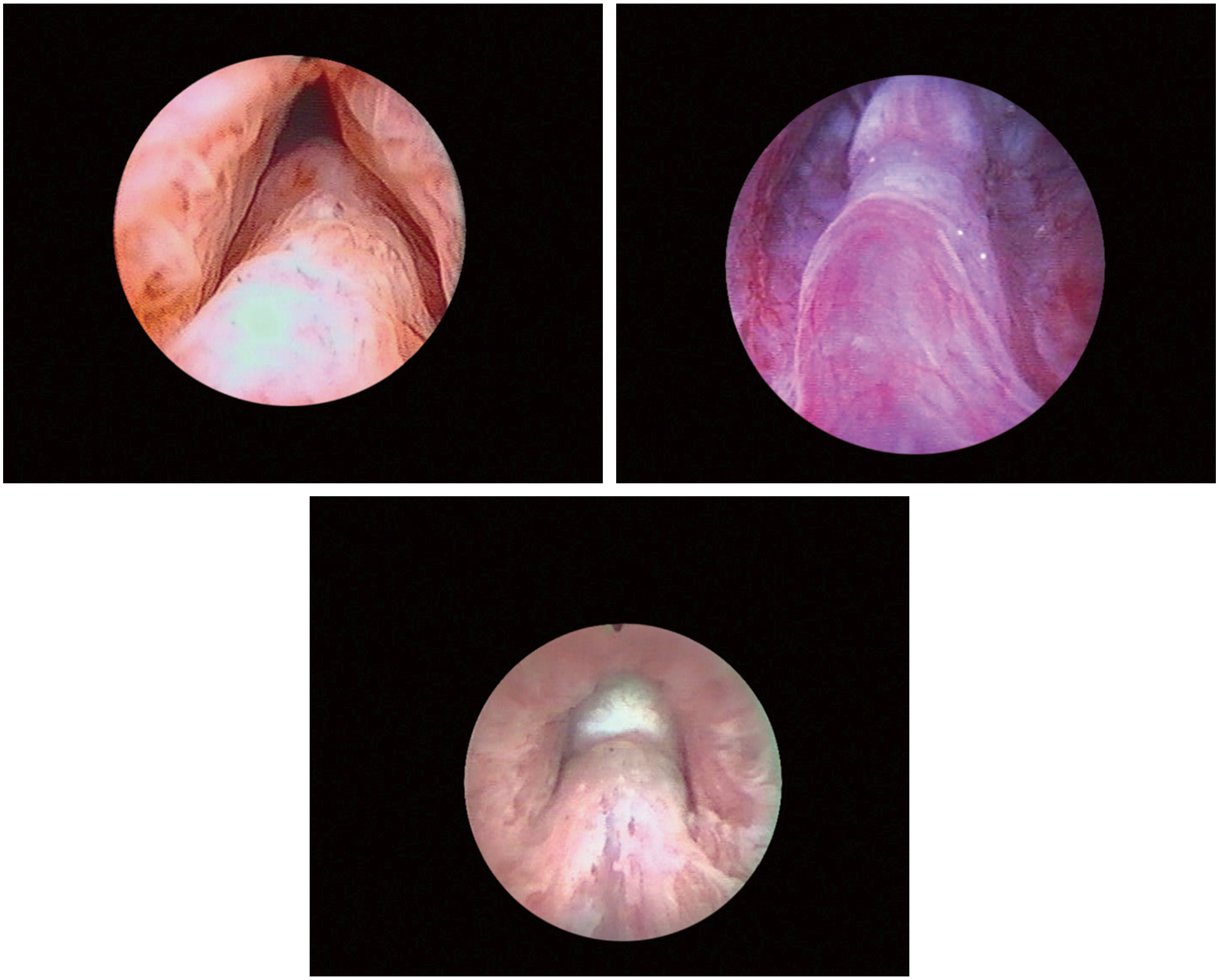

FIGURE 12.4 **"Humpback" verumontanum.**

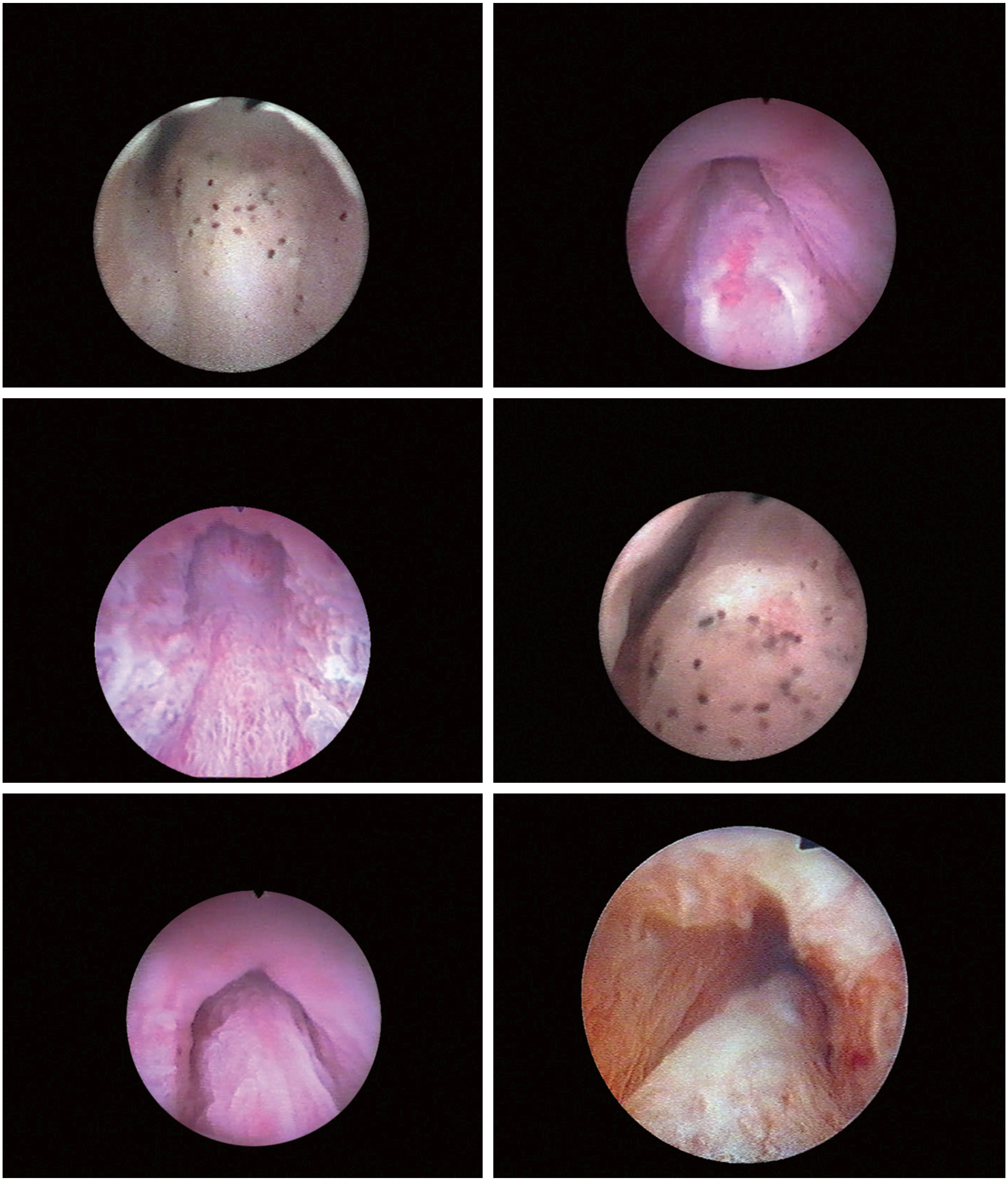

FIGURE 12.5 Very long verumontanum.

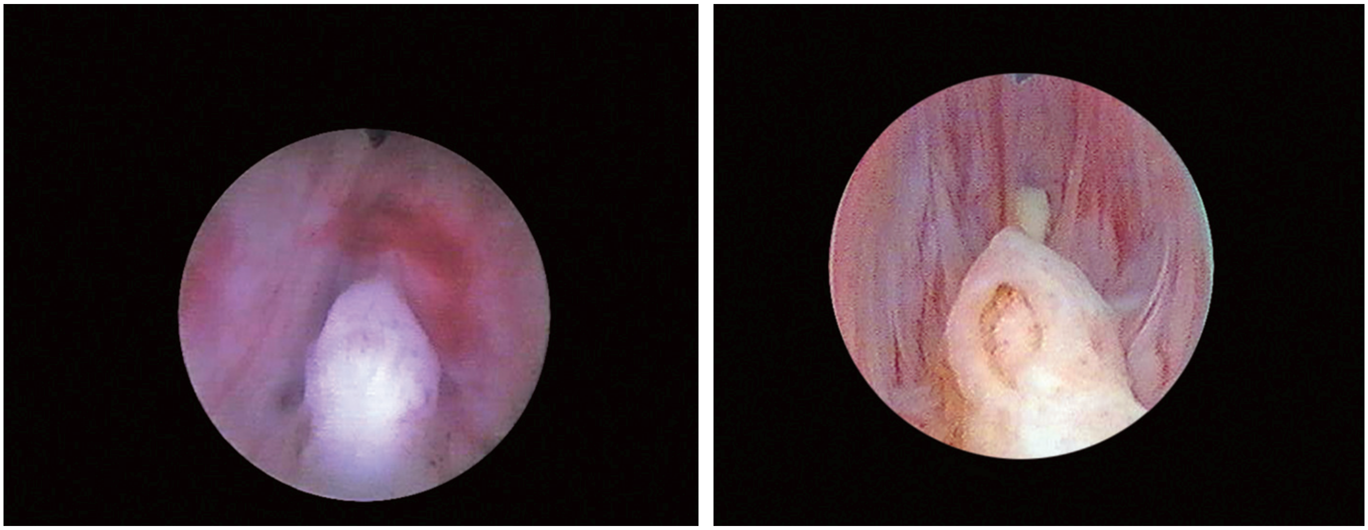

FIGURE 12.6 **"Helmet" shaped verumontanum.**

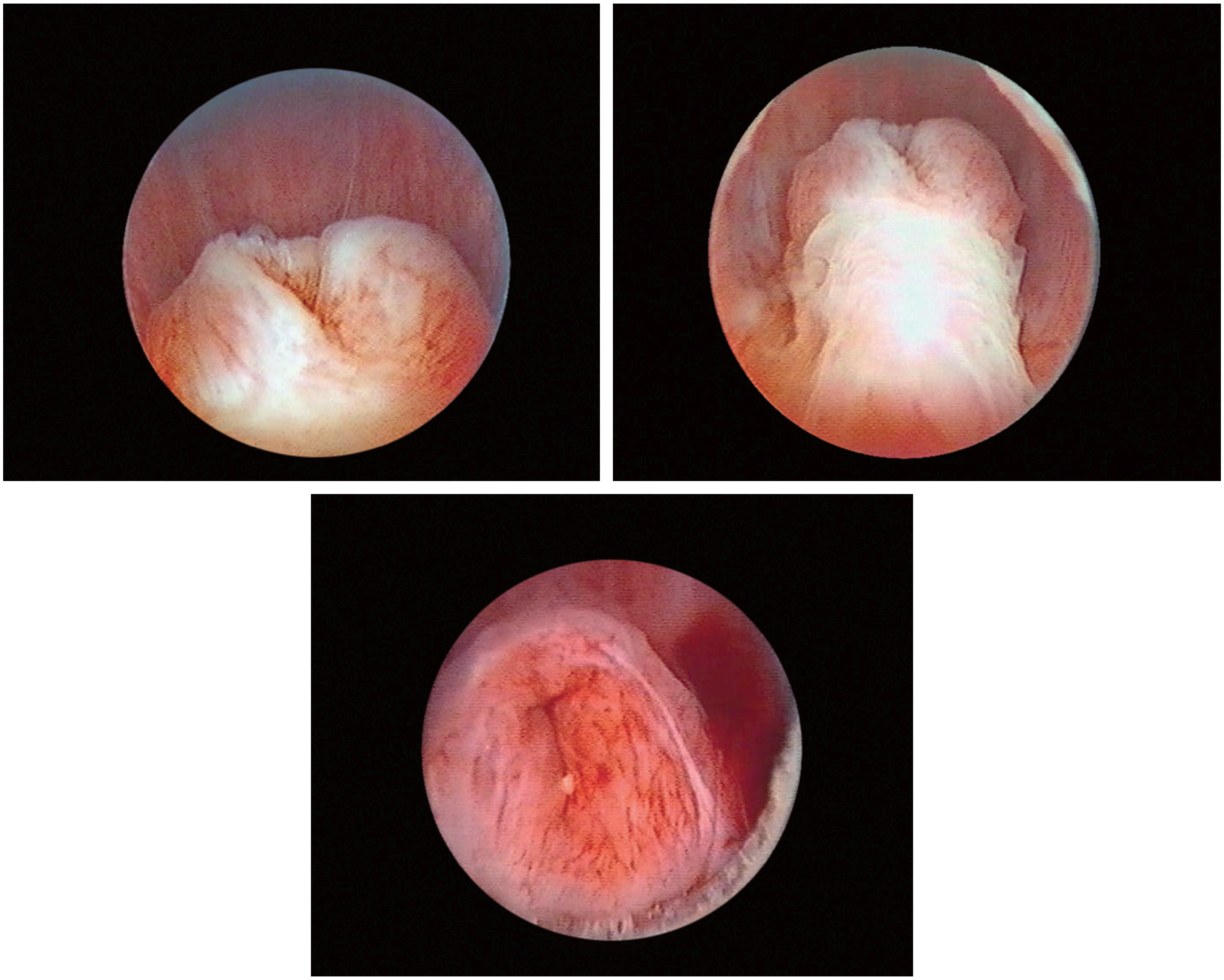

FIGURE 12.7 **Verumontanum with the aspect of a diverticulum.**

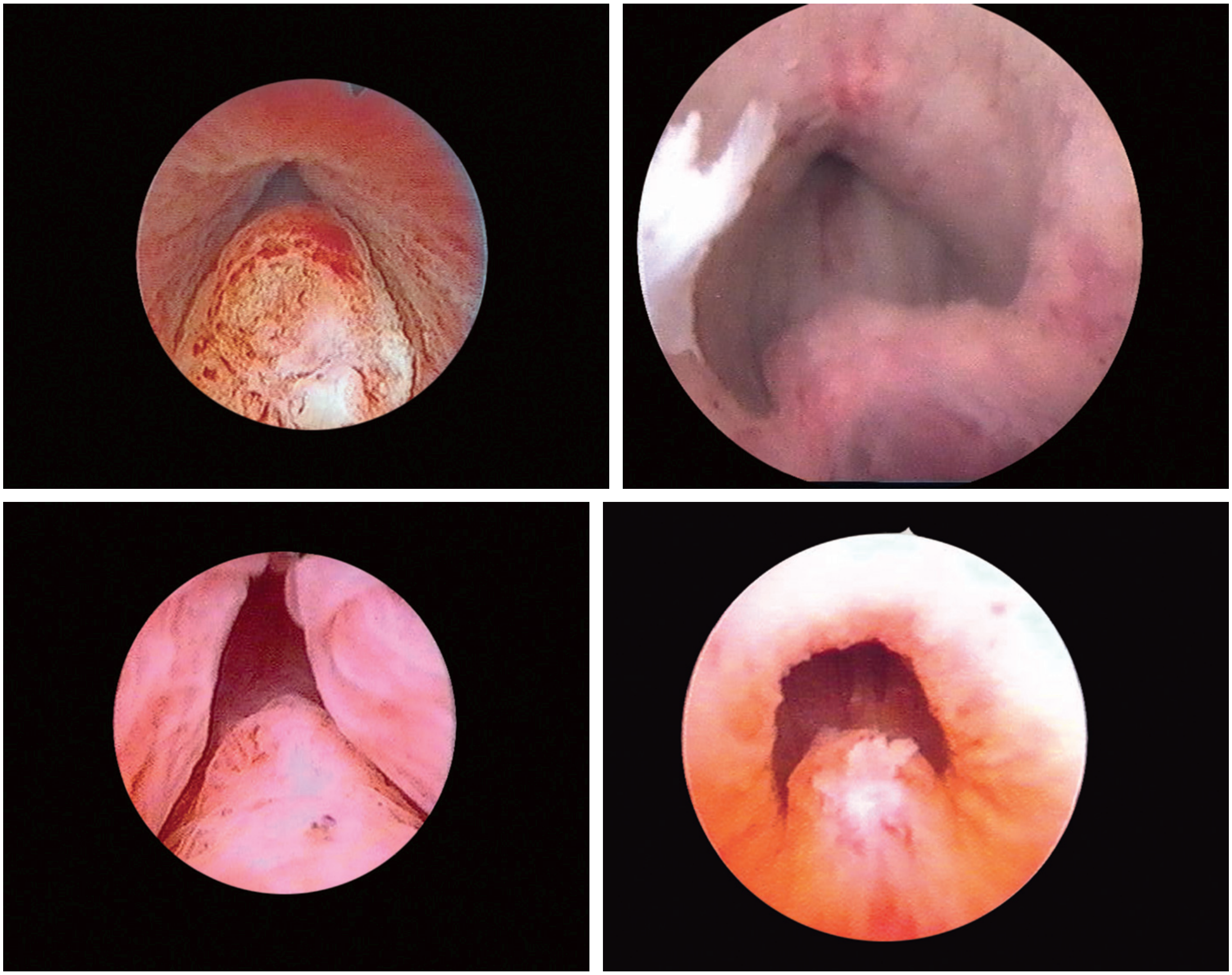

FIGURE 12.8 **Other forms of verumontanum.**

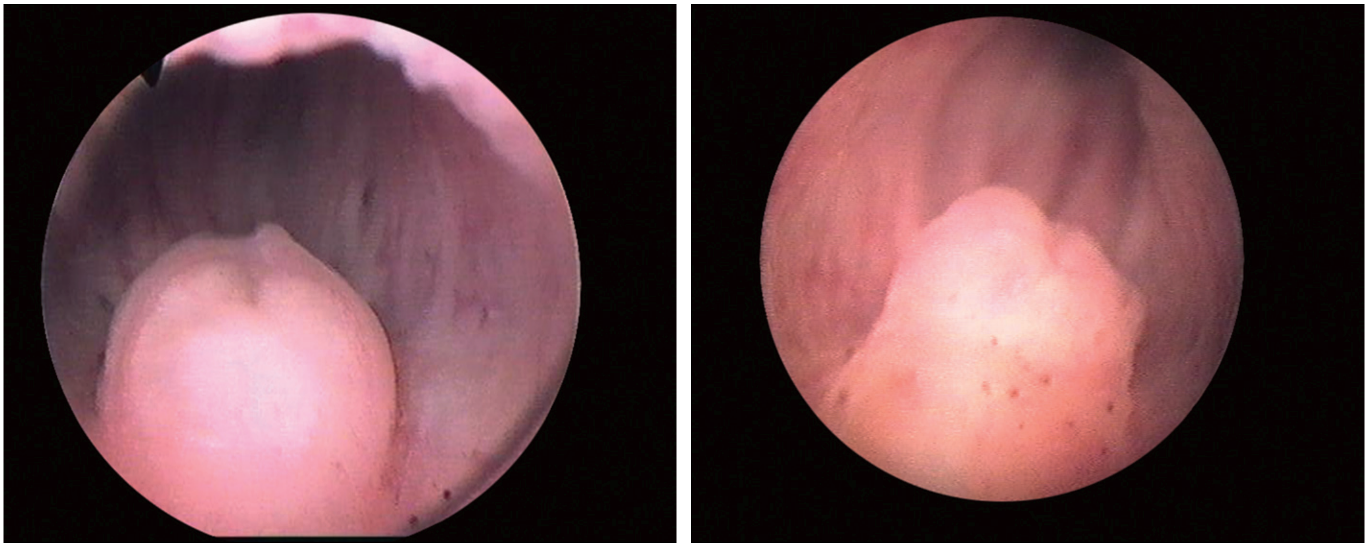

FIGURE 12.9 **Aspects of verumontanum with urinary significance.**

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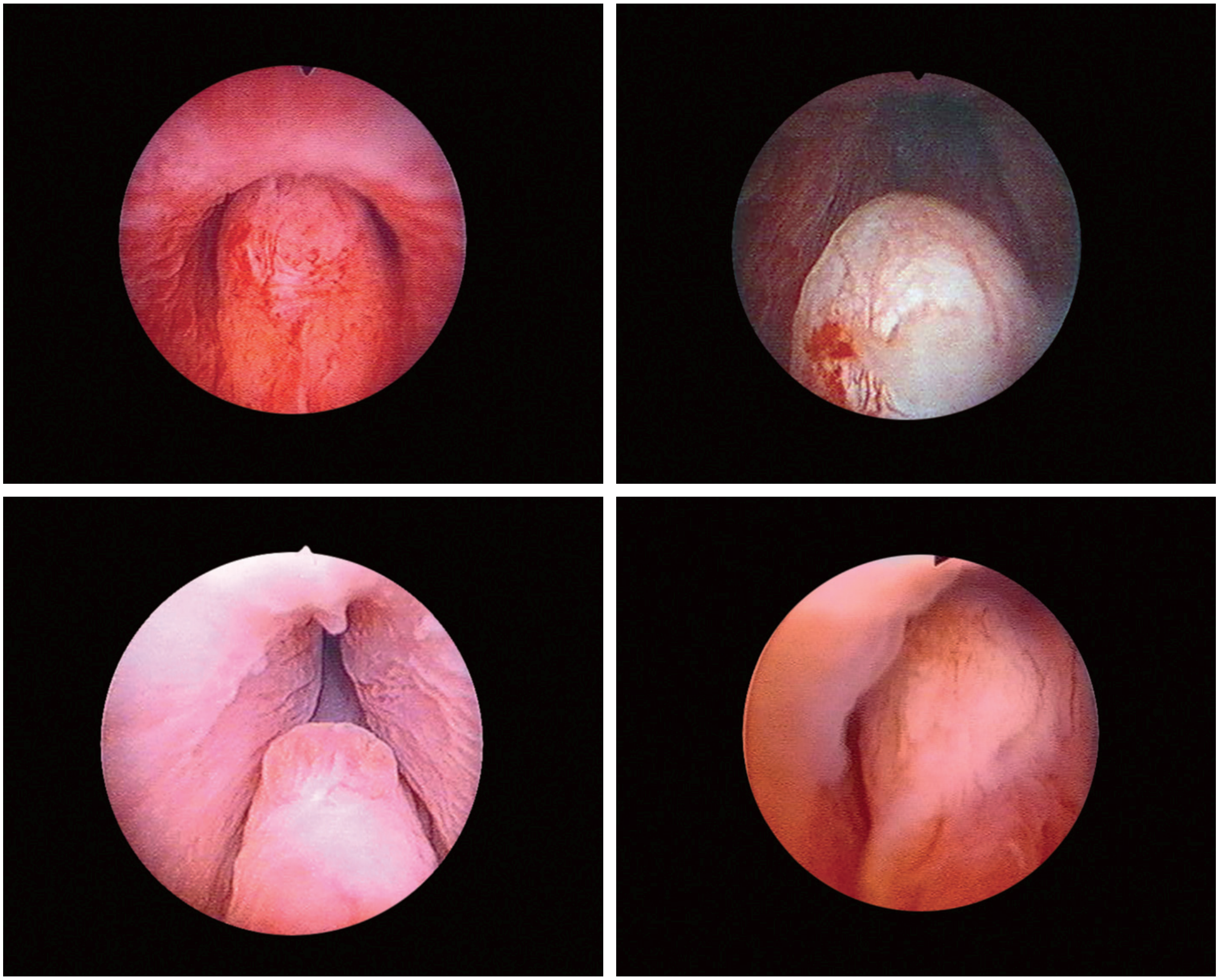

FIGURE 12.9 *(Cont.)*

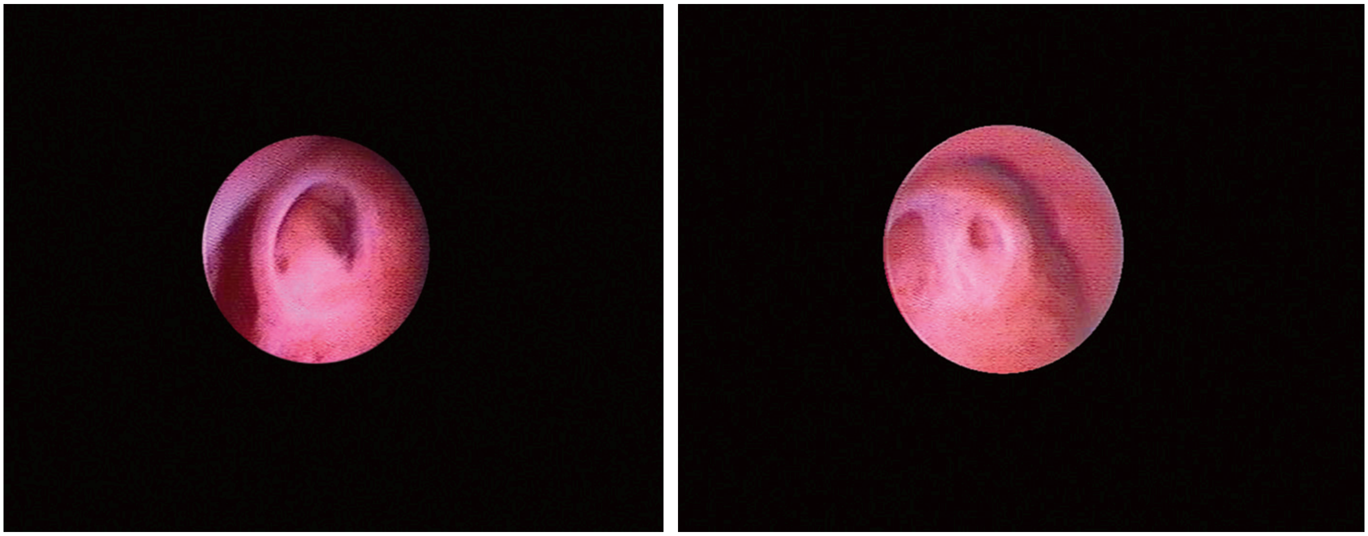

FIGURE 12.10 **Aspect of verumontanum suggesting a genital pathology.**

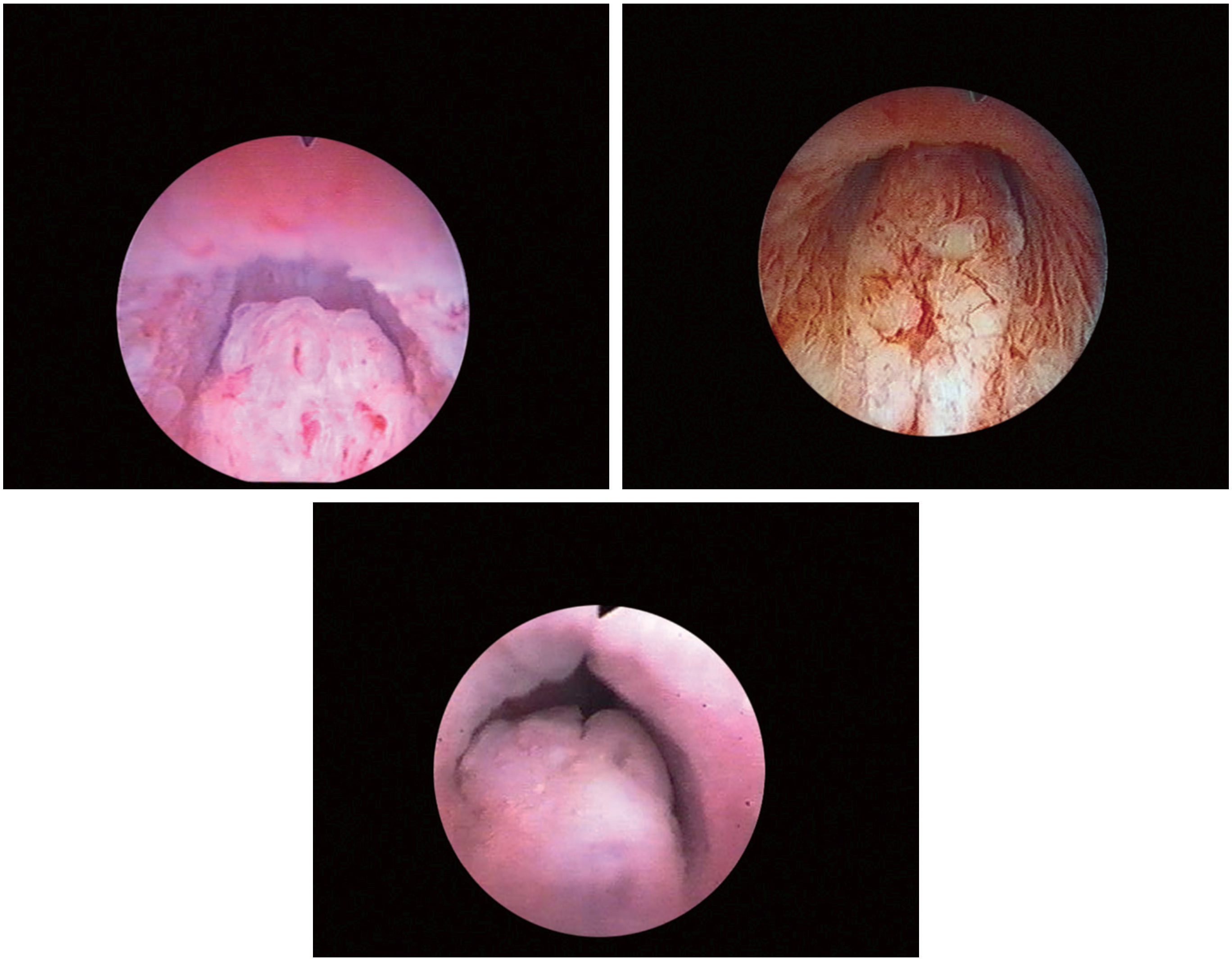

FIGURE 12.11 **Acute inflammatory lesions in verumontanum.**

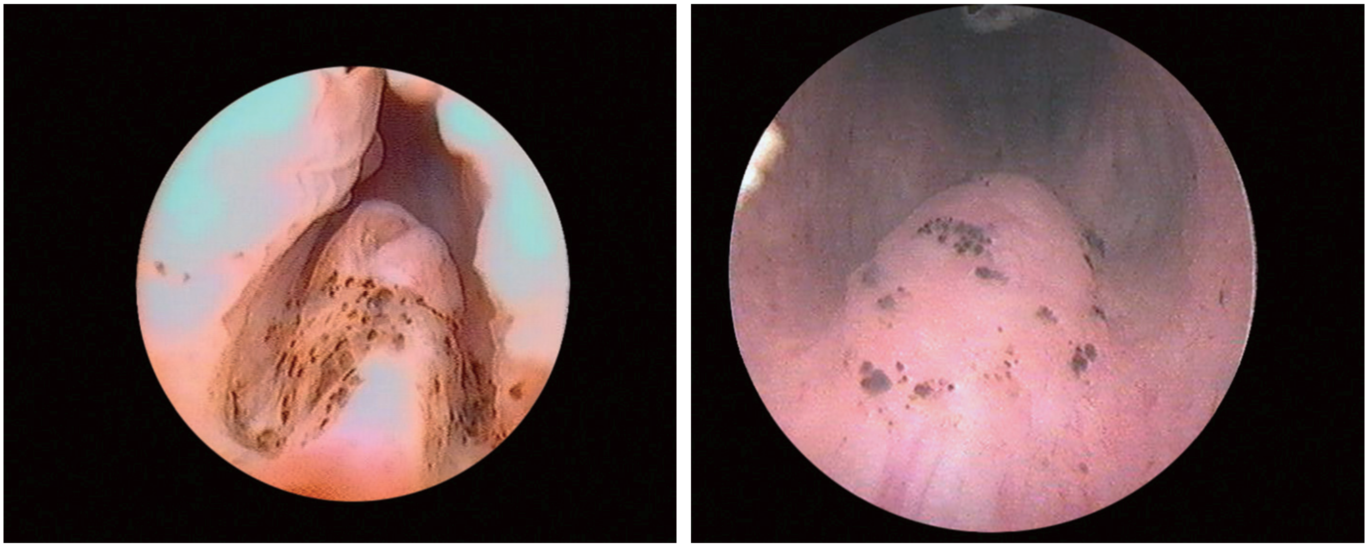

FIGURE 12.12 **Chronic inflammatory lesions in verumontanum.**

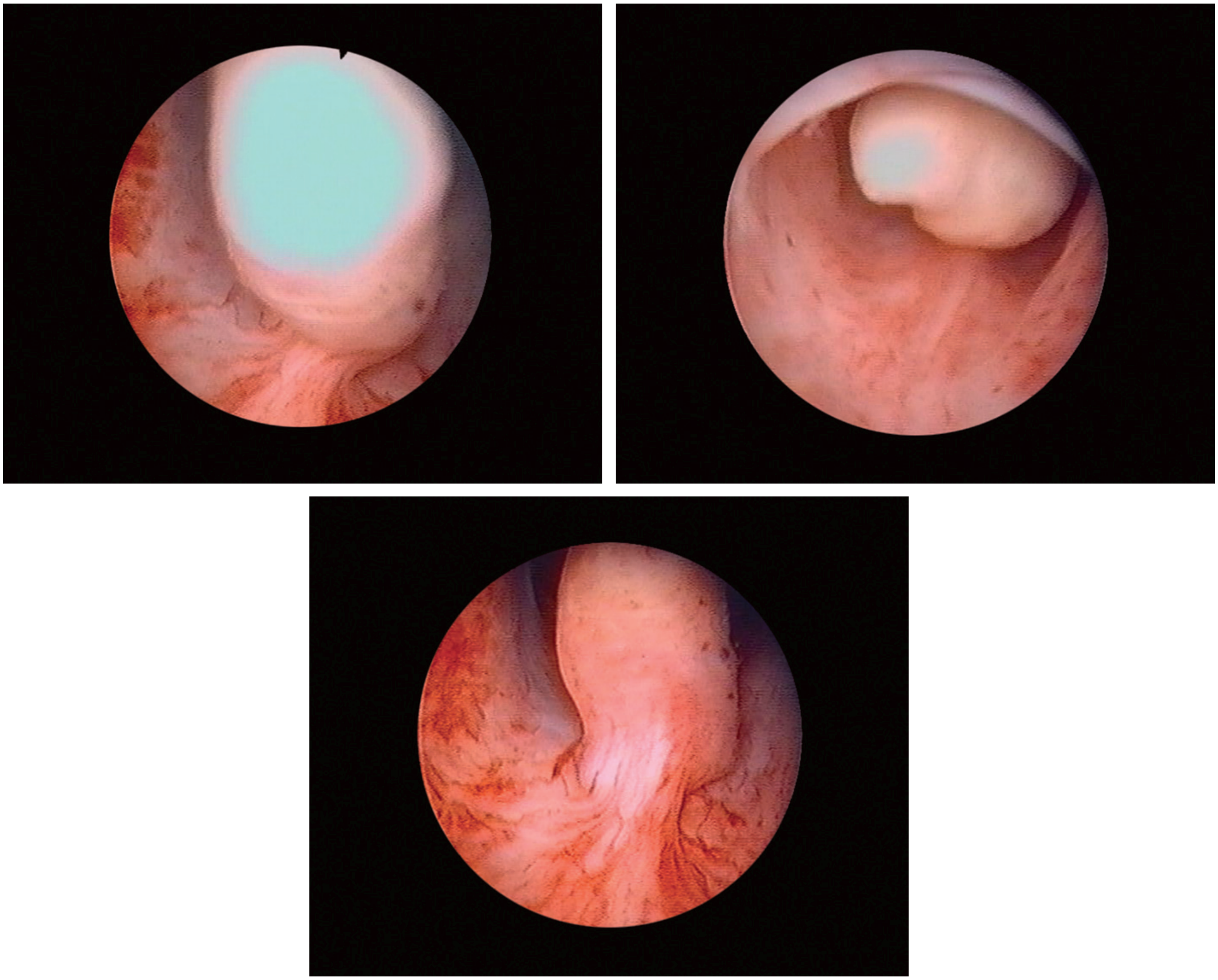

FIGURE 12.13 Fibroepithelial polyp implanted in the verumontanum.

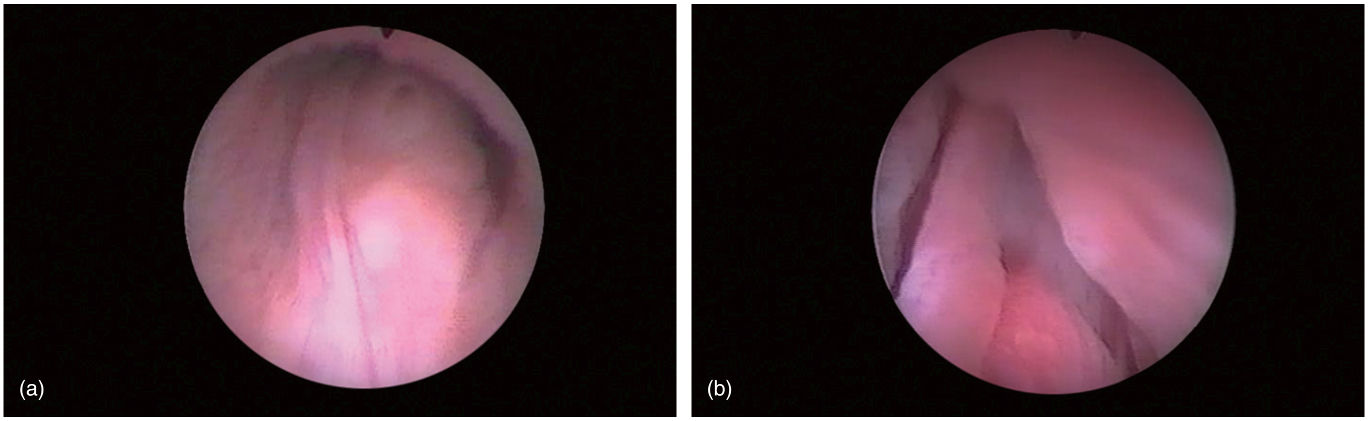

FIGURE 12.14 Fibroepithelial polyp implanted in the dorsal portion of the verumontanum (a, b, c), detached using a biopsy forceps (d, e, f).

(Continued)

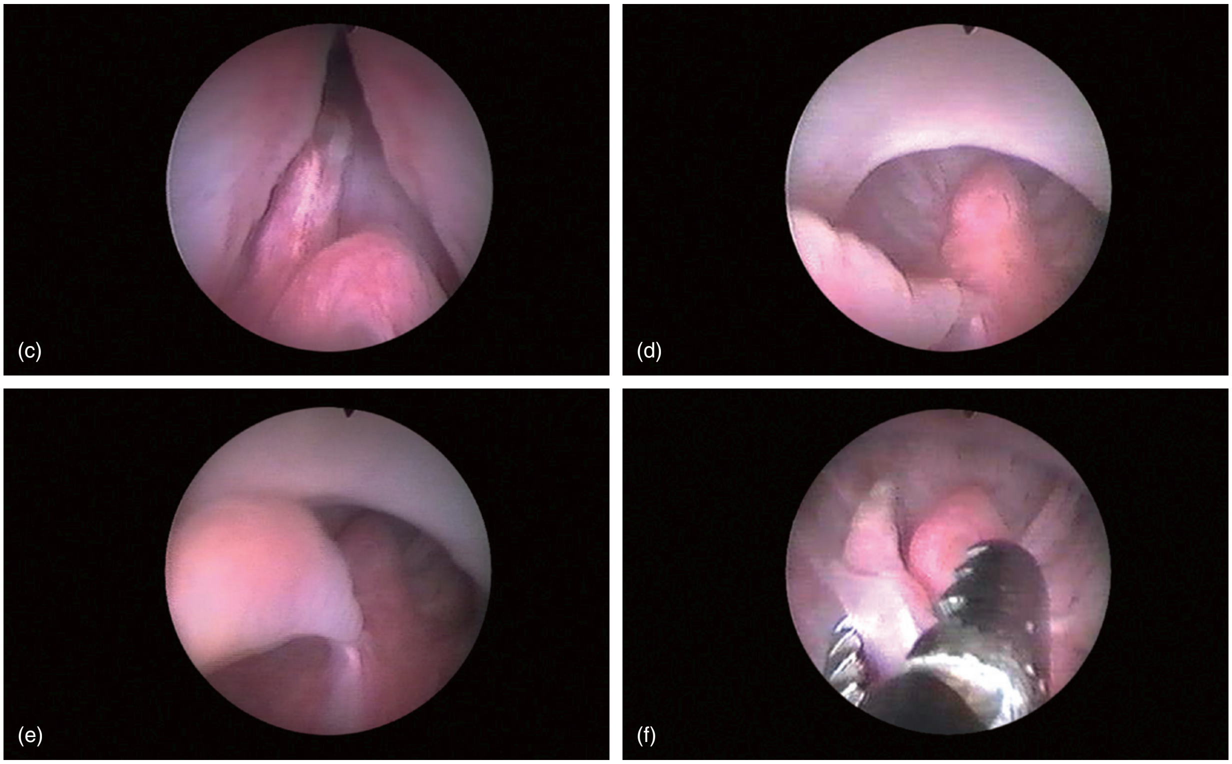

FIGURE 12.14 *(Cont.)*

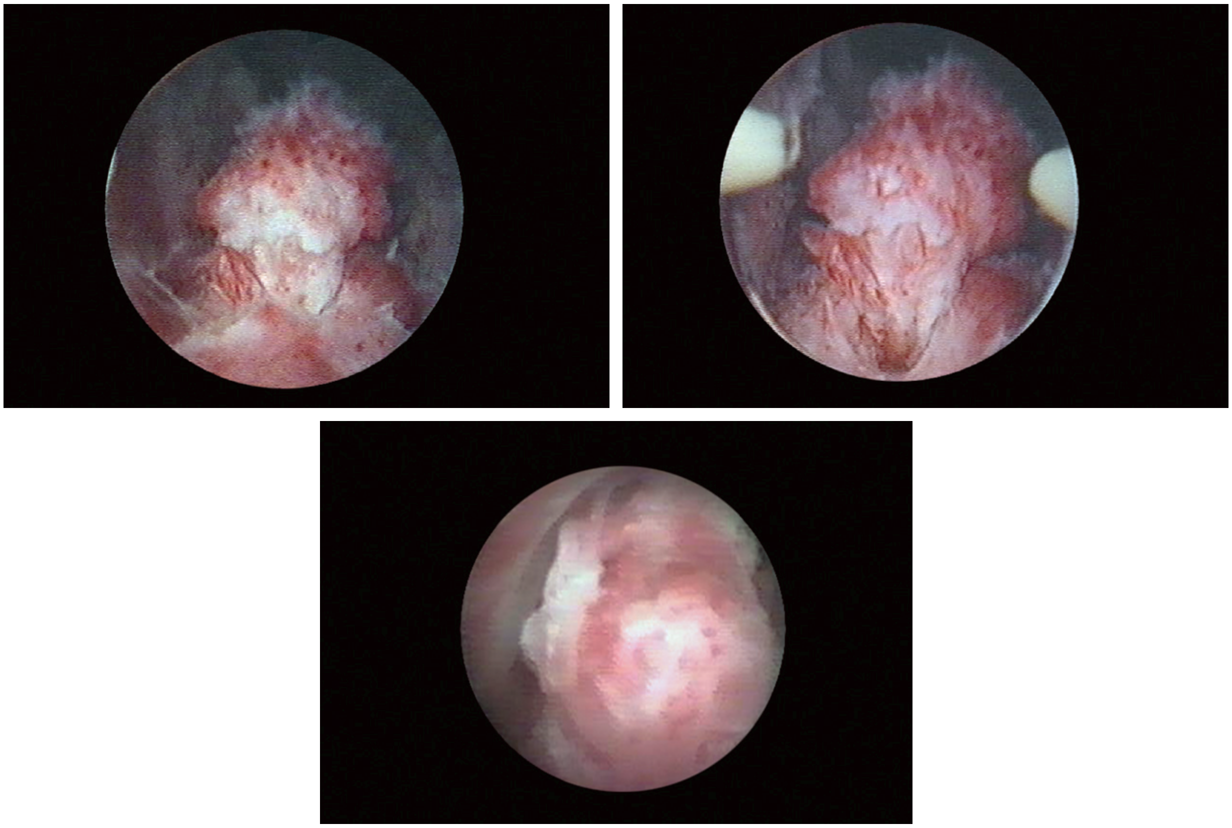

FIGURE 12.15 **Aspects of carcinoma originating in the prostate ducts.**

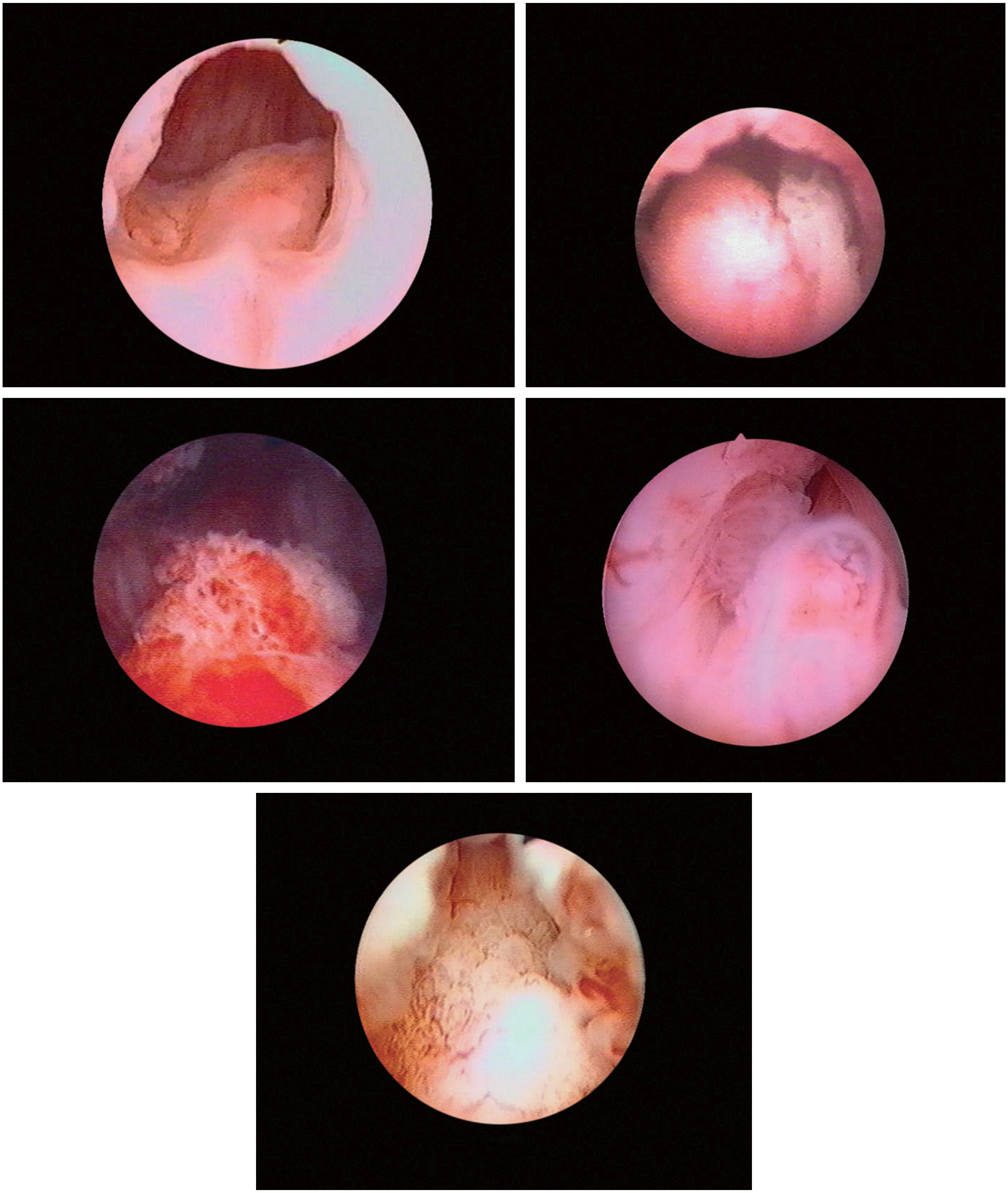

FIGURE 12.16 **Endoscopic aspects of primitive malignant tumors, originating in the verumontanum mucosa.**

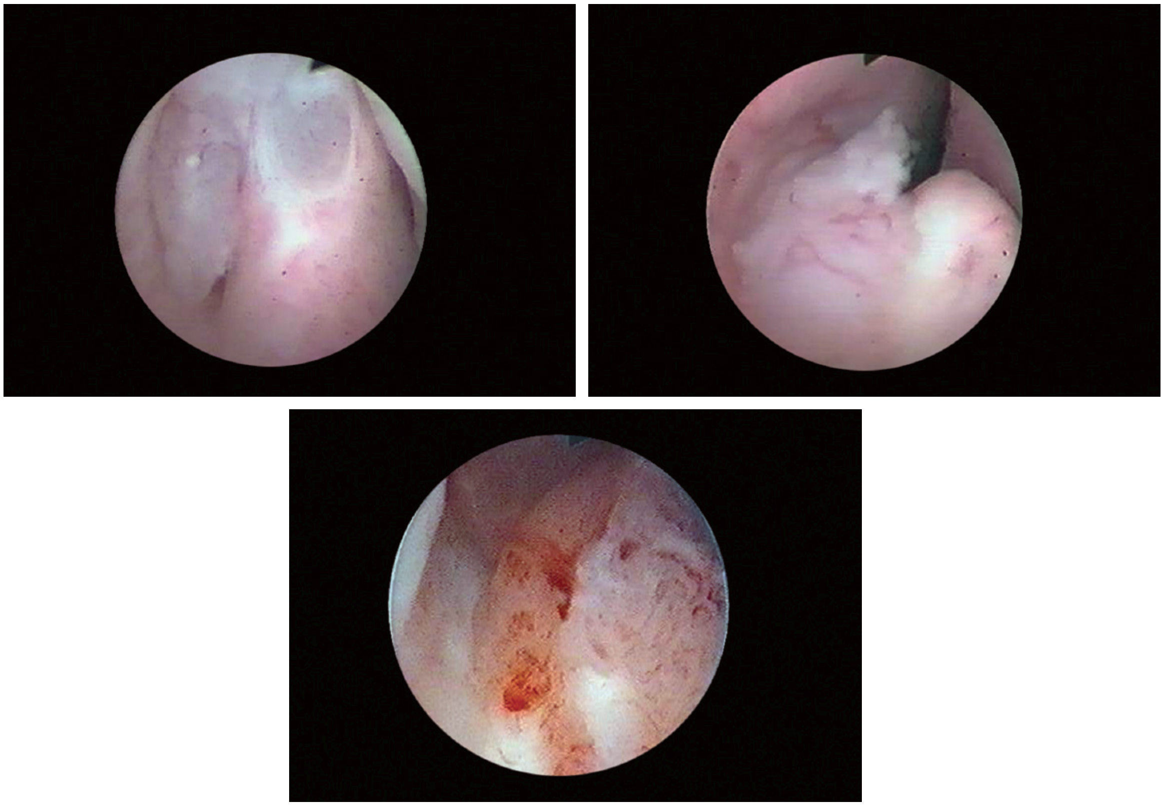

FIGURE 12.17 Aspects of verumontanum urothelial tumors, secondary to bladder masses.

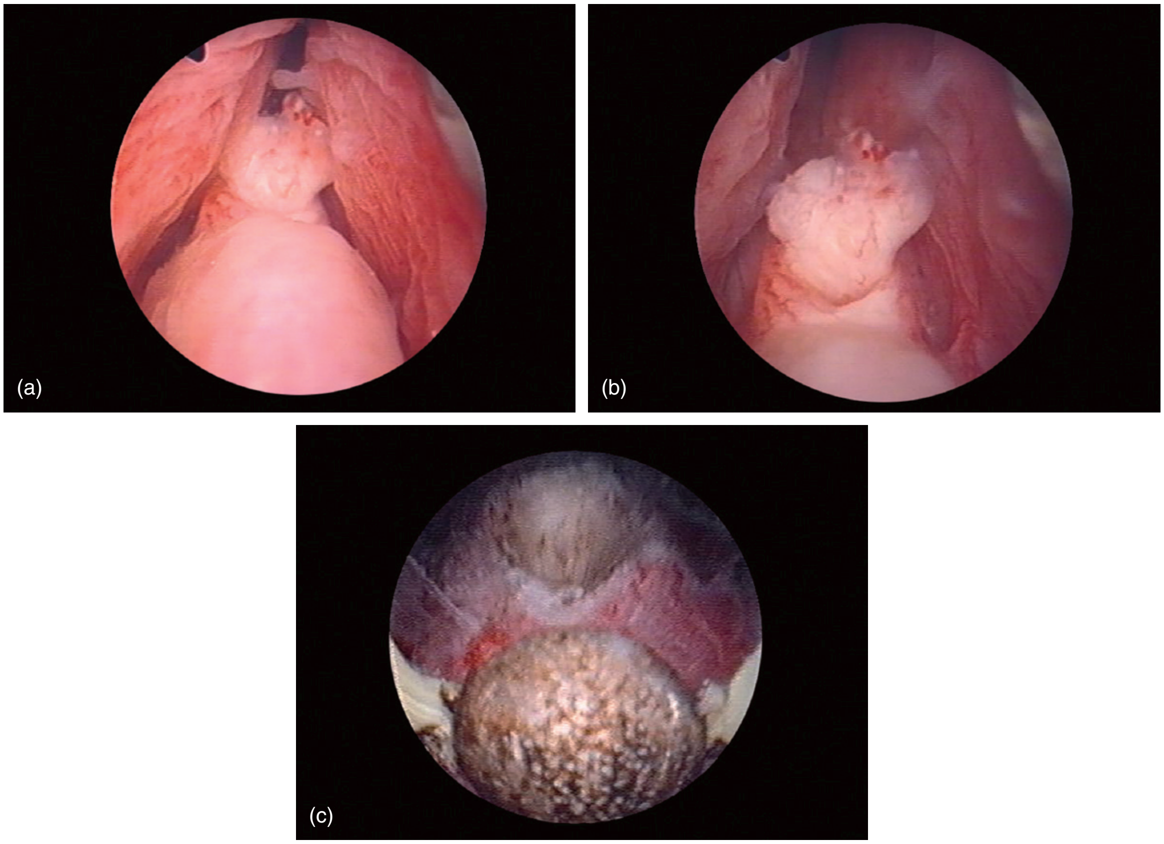

FIGURE 12.18 Verumontanum tumor (a, b) endoscopically resected up to healthy tissue (c).

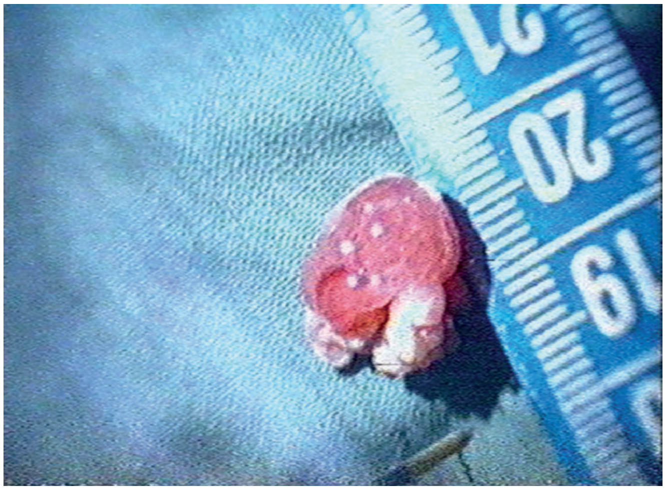

FIGURE 12.19 **Resected tumor aspect after extraction.**

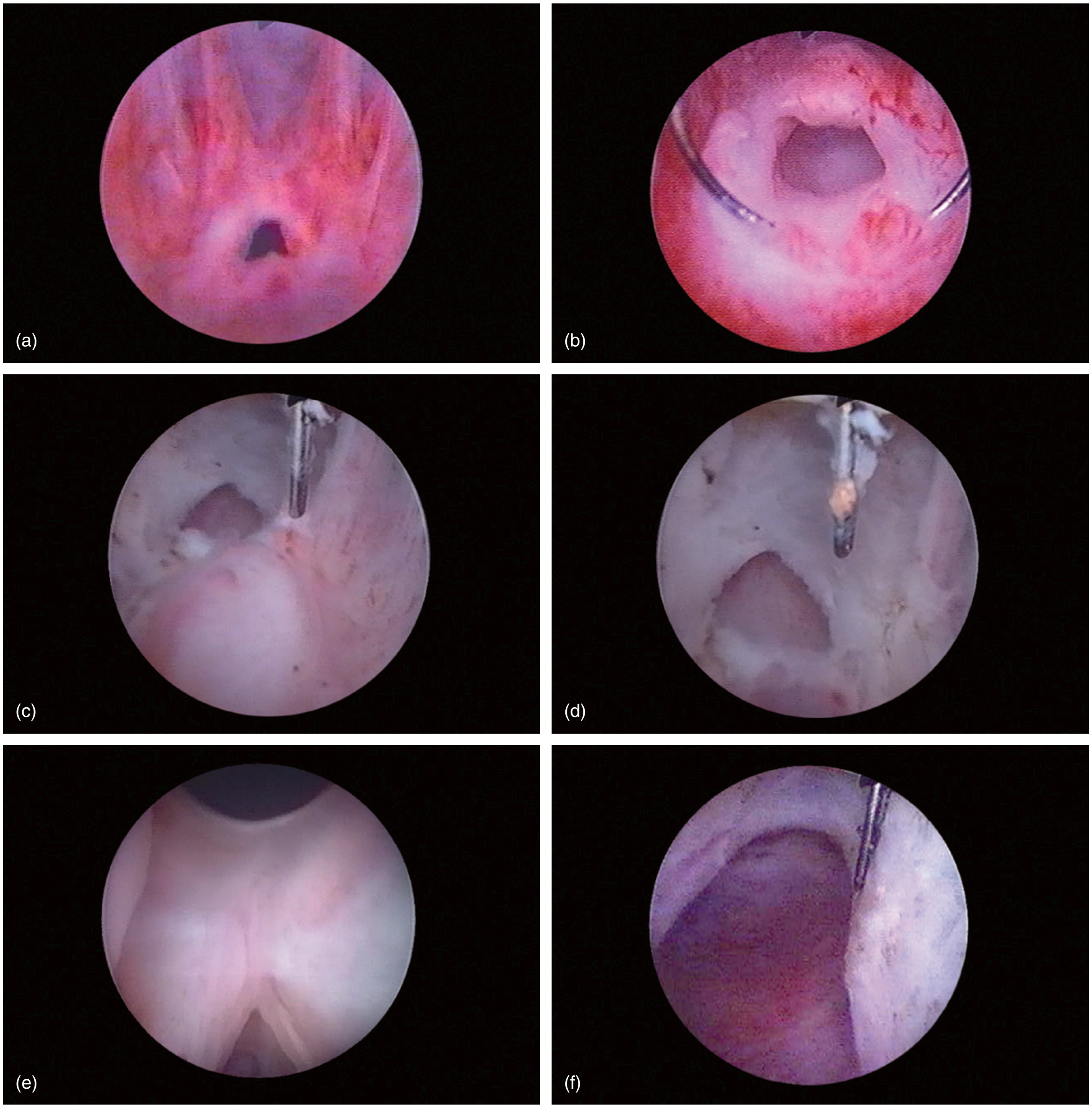

FIGURE 12.20 **Prostatic utricle cyst (a, b), incised with a Collins loop (c, d, e, f).**

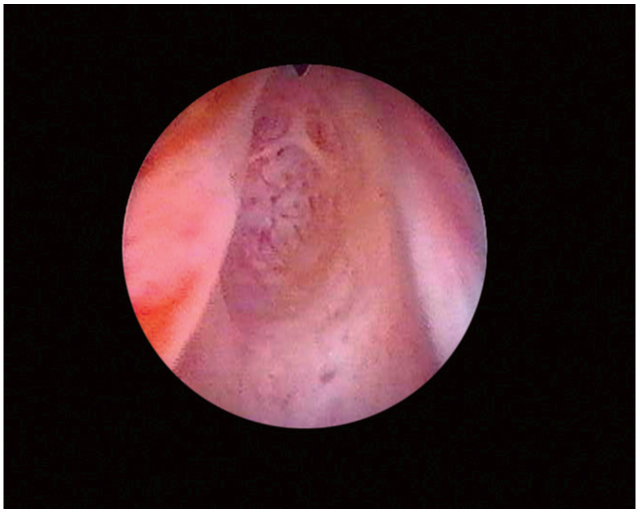

FIGURE 12.21 Appearance of the incised prostatic utricle cyst, 1 month postoperatively.

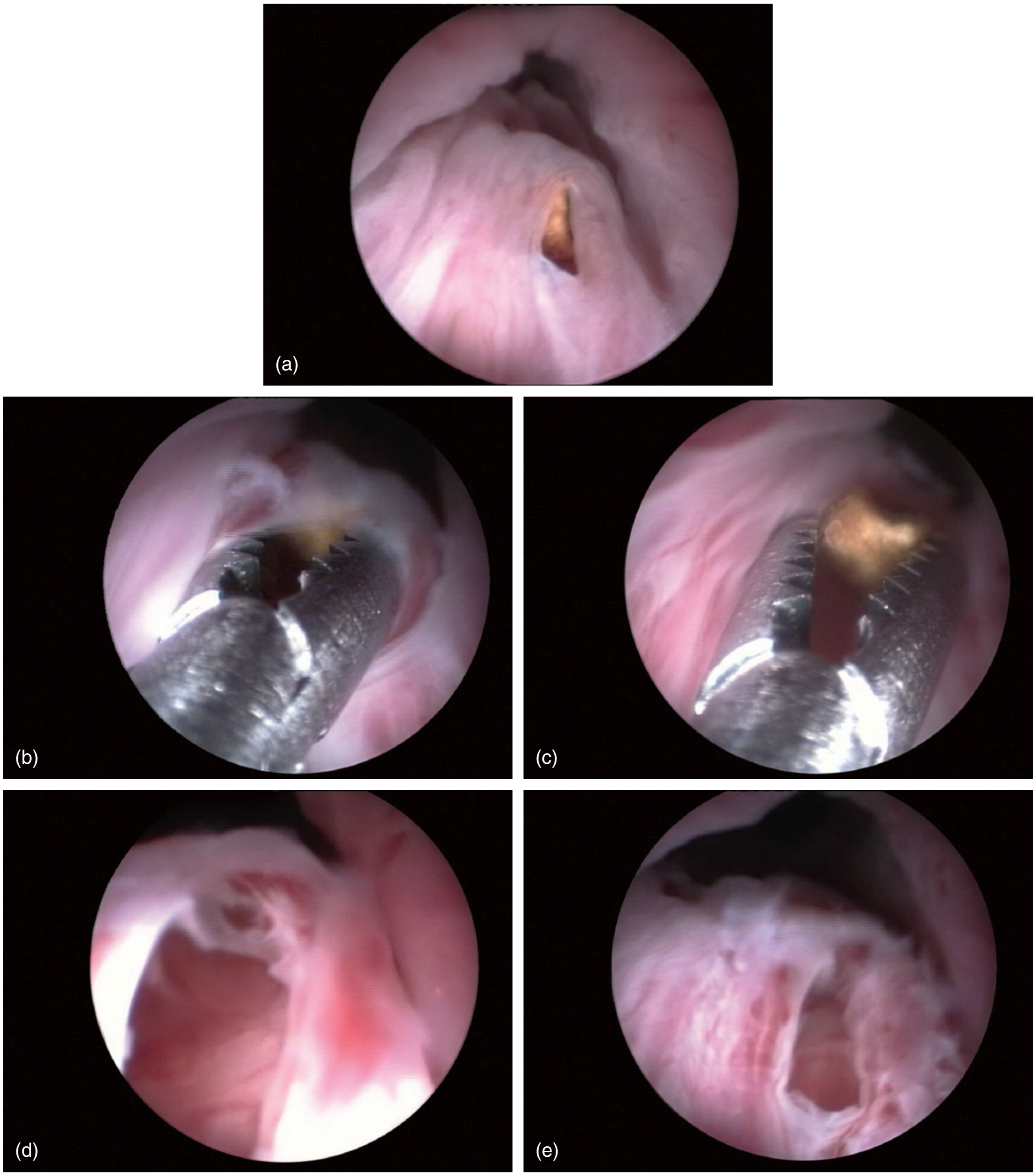

FIGURE 12.22 Stones in the prostatic utricle (a), extracted with forceps (b, c), and aspect of the verumontanum at the end of the procedure (d, e).

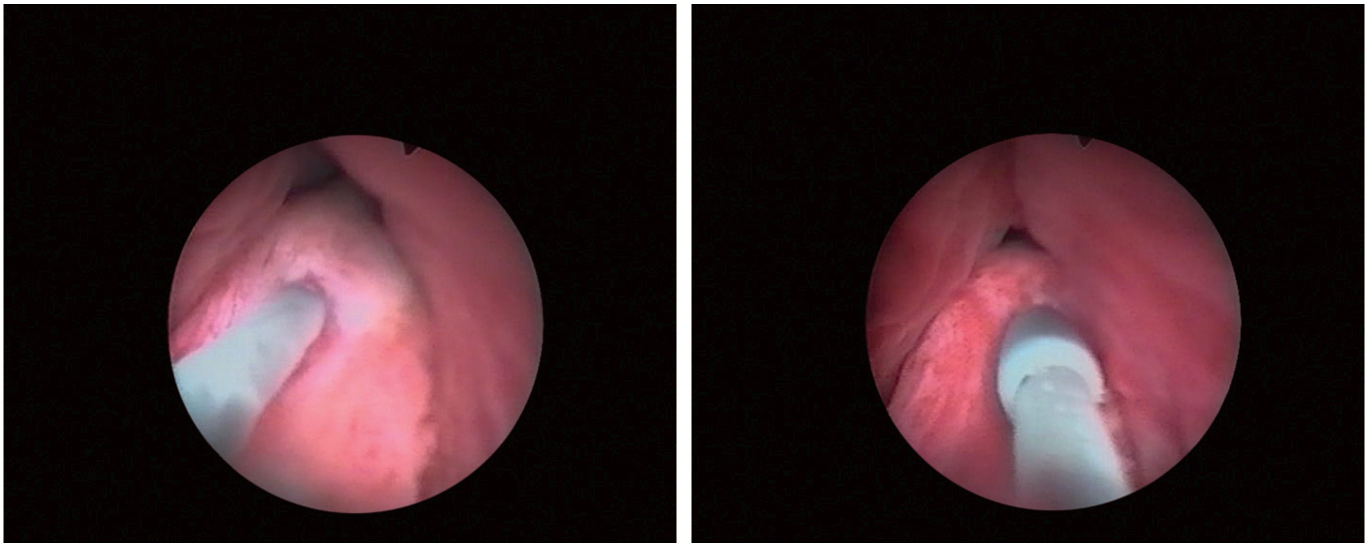

FIGURE 12.23 Catheterization of sperm path in the verumontanum during retrograde deferentography.

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Endoscopic Diagnosis and Treatment in Urethral Pathology

HANDBOOK OF ENDOUROLOGY

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